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Grain Handling

WORLD CROPS

The International Journal of Agriculture

VOLUME 11, No. 3 MARCH 1959

A Publication of The Leonard Hill Technical Group

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Editor: Frank Cooke, A.R.C.S., B.SC., A.M.I.CHEM.E., E.D.

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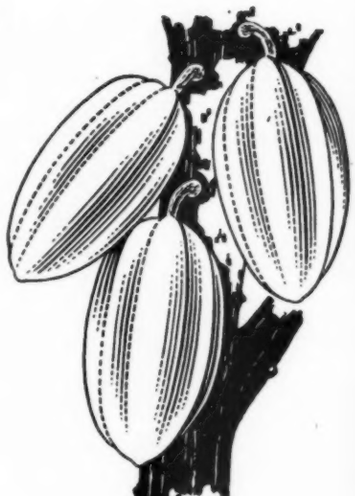

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Editorial Comment

The great dilemma

FARMERS ARE growing more wheat than ever before in history, and world wheat supplies in 1958–59 will probably reach an all-time record. Statistics issued by FAO indicate that the output will not only be larger, but substantially larger than last year with increases in what are now rather surprisingly, the three largest wheat-producing countries—the U.S.A., Russia, and China. In 1957, the ' Big Four ' were U.S.A., Canada, Australia, and Argentina, *vide* WORLD CROPS, **9**, 1957, 360; thus while three of the leading producers have managed to reduce their production, other countries have been forging ahead.

It is apparent that efforts to restrict supplies have failed, and the machinery for surplus disposal is not effective. The solution of the serious problems of agricultural surpluses will have to be found through new efforts to increase consumption. Senator Mansfield from Montana is urging that current American farm surpluses should be diverted into foreign aid channels to get ' these surplus foods into the hands of the peoples of the world who have only one meal a day and have no means of buying more food '. There are, however, producers who state that this will upset markets and damage the price structure.

Some new machinery is needed to ensure that no man goes in want, while the silos of the big producing countries are filled to over-flowing and wheat prices are only being saved from total collapse by arbitrary price-fixing agreements.

International agreement

AT THE recent Conference of the International Federation of Agricultural Producers, held at Brussels, it was resolved that : . . . an International Wheat Agreement . . . is urgently required in order to assure a substantial trade in wheat at reasonable stable prices at a reasonable level for the benefit of both exporting and importing countries . . . and to facilitate utilisation in under-developed countries of the large existing surplus . . . and since substantial quantities of wheat should continue to be disposed of in such countries on a non-commercial basis, the new Agreement should provide for procedures and price conditions . . . and for consultations by governments concerned with the International Wheat Council so as to guard against undue disturbance to the normal channels of trade.

This is all very well but the disposal of the wheat surpluses will still be according to the political whims, fancies and favours of the individual producing nations; there will also be strings attached – visible and invisible – which are so humiliating to the receiving nation, and there will continue to be disputes among the producing nations regarding the effect of these surplus disposal operations on prices. It has yet to be recognised that it is as much in the interest of the producer that the wheat should be consumed as it is for the needy nations to obtain more food, so that their peoples may gain in strength and not fall further and further behind. The major problem is emphatically *not* over-production but chronic mal-distribution.

Mr. B. R. Sen, the Director General of FAO, in announcing the plan for a ' Free-the-World-from-Hunger ' Year in 1963, said ' This is the biggest human problem of the century beside which other problems that today absorb our attention and energy are really trivial and of temporary significance. The dilemma of hunger and agricultural surpluses is one of the most baffling paradoxes of our time, and FAO's attempts to find a world-wide solution to the paradox have been thus far without success '.

Pooled wheat

THE SOLUTION, we submit, lies in the establishment of a World Wheat Pool to take this essential commodity right out of the realms of commodity speculation and political bargaining. A Central Board should be set up to accept as a paper transaction *all* the wheat produced in all the producing countries and to arrange for its sale to all importing countries at a managed price, and for the disposal of the surplus among the needy countries, allowing a buffer stock to allow for fluctuations in the harvests and to steady the managed price.

Pooled pineapple

IT WAS on these lines that the bankrupt Singapore Pineapple Industry was so successfully reorganised in 1936 and re-established from nothing after the war, in 1946. The Central Board of Pineapple Packers now takes up all the canned pineapple produced and manages the price by mutual agreement with the buyers, who in this case are the shippers, who are, of course, represented on the Board. In this way, cut-throat competition was abolished, quality standards were established (where none existed before) and a steady price, fair to the pineapple growers, the canners, and the ultimate consumers, has been maintained ever since. The commodity is, of course, shipped direct from the individual canneries to the consuming countries, the operations of the Pool being simply paper transactions.

It is interesting to our readers that the establishment of this Pineapple Pool among the Chinese growers and canners was the work of Sir Harold Tempany, the first editor of WORLD CROPS.

Agricultural progress

EVERY FARMING and horticultural journal in the U.K. carries accounts of new machines and new mechanised processes involving the use of complicated harvesters, ditchers, seeding machines, down-the-row thinners, forage harvesters, and ploughing and cultivating machinery of all kinds.

Yet in the use of such machines, Britain is in many ways a backward country. One sees pictures of tractors drawing ploughs and cultivators a cross slopes that would be considered too steep for cultivation without terracing, or only fitted for pasture grass or forest in other countries. Few farmers in Britain work their land on the contour; few have adopted rotated strip cultivation; and among the fruit growers, how many have ceased to plant on the square?

Prizes are given for the straightest furrow, even though it may run up and down the slope. Erosion prevention is neglected, even though freak storms will cut deep runnels down these ploughed fields, carrying the valuable topsoil down into the valley and away to the sea. Correct contour cultivation will not only check the rush of storm waters, but will actually conserve water, and yet, south of a line drawn between Bristol and the Wash, the country could do with an additional 5 in. of rain per annum.

In spite of the progress that has undoubtedly been made in the use of weedkillers, South Africa and Kenya are ahead in the cleanness of their pastures. Their farmers would be shocked to see the buttercups, white daisies, docks and thistles and blackberry, bracken and gorse which is still allowed to invade so much grazing land in this country.

To lead in mechanisation alone is not enough; more attention now needs to be given to improving agricultural practice to raise the productivity of the land to its full potential.

Fragrance sells fertilisers

ONCE UPON A TIME a fertiliser was judged by the strength of its smell – if it put up an aroma like a ripe Camembert it was obviously full of plant foods. This, of course, was in the days when a fertiliser was looked upon as a substitute for animal manure and not as a different kind of plant nutrient provider. In the earlier period of chemical fertiliser compounding some firms deliberately added strongly malodorous substances.

Now it seems the wheel has turned full cycle, and in the U.S.A. pleasant odorants are being added to garden fertilisers. The aim is not *nuit d'amour* or *eau de Cologne*, but to suggest the sweeter undertones of rural scents – moist soil, new-mown hay, or fruity scents, such as citrus or apple esters. The odours of pine or even vanilla have been used. A firm marketing a lawn fertiliser containing fish-derived materials received many complaints that it attracted cats and dogs; the complaints ceased when an odorant which masked the fishy smell was introduced. Another firm, making a liquid fertiliser called ' Rosy Future ', is reported to be adding phenyl ethyl alcohol to give the product a rosy fragrance, which no doubt fits its name and assists sales promotion.

At first thought this attempt to gild the lily might seem to be pandering to absurdity on the ignorance of the customer. But it has its marketing virtues. Small packs of garden fertilisers are sold, and probably increasingly, at self-service stores in America. If these packs smell bad they are unlikely to be placed in good positions to attract the customer's eye; for the same reason, a decision to buy might be postponed because the smell of the bag of fertiliser would be objectionable among other purchases being made at the same time. The cost of adding a suitable odorant might seem unnecessary, but in this class of fertiliser trade the actual cost of the material in the pack is much smaller than the total of other on-costs, such as packaging, transport, selling etc.

There is, in any case, a much-advertised parallel (or it may be a precedent) for protecting the domestic buyer from the odorous facts of life. A well-known brand of paraffin is not only being nationally sold ' in the pink ', but its natural aroma is masked. If the smell of a product makes it hard to sell, or objectionable for other reasons, why not do something about it?

Space race

ACCORDING TO *Jane's All The World's Aircraft:*

' The past year has seen space flight develop from scientific fiction to scientific fact. American satellites have followed the Russian sputniks into orbit, and one of them is expected to continue encircling the earth for 200 years '.

Much has been learned about conditions in interplanetary space, and vehicles which will enable man to follow the paths of the artificial satellites are already on the drawing boards. One weak link remains – the space traveller. He appears likely to present the greatest obstacle to successful space travel.

What is to happen to a man when he embarks alone for his voyage into the unknown to live for months, perhaps for years, shut up in a tiny box, with every chance of not returning at all? There are psychological problems of boredom, and loneliness, alternating with periods of stark terror, the awful physical problem of weightlessness and the maintenance of physical and mental health, but, above all, an obsession about food will be inevitable.

For a short voyage it is possible to provide varied and tasty concentrates, and for a longer excursion into space it may be possible to carry on for a time on tablets, though, lacking in bulk, these may permanently impair his physical system. It may also be possible to put him to sleep, so that he can ' hibernate ' until his arrival,

but for a long voyage into space – a trip of two or three months – needed to reach the nearest planet it will be necessary to provide him with fresh food – balanced and tasty – if his morale is to be maintained, so that he can arrive physically, morally and mentally fit enough to face the unknown on Mars.

At the world's first symposium on submarine and space medicine, arranged by the American Institute of Biological Sciences, it was reported that a new strain of algae can increase by cell multiplication one thousand-fold each day. The idea appears to be to organise farming in space in much the same way as here on earth. According to a paper put out by the Quartermaster Food and Container Institute for the Armed Forces of the U.S.A., entitled 'Closed Cycle Biological Systems in Space Feeding', the space traveller will be supplied with food, water and oxygen by biological and chemical processes, assisted by the sun's energy. He will eat the food, turning out the same wastes in the spaceship as he produces here on earth to be converted back on the pattern of nature's cycle.

Devastatingly Dr. Harvey E. Savely remarked in an interview with Daniel Lang (*New Yorker*, 15 November, 1958): 'The prospect of having spacemen grow and harvest algae strikes me as anachronistic. To think that we may develop such an advanced machine as a spaceship and have to fall back on so primitive a calling as agriculture!'

And what, then, is to come out of all this new research into the unknown? Perhaps the food of the future and the answer to the growing problem of feeding the world's people. Will such artificially produced algae and the passively drifting pelagic life of the sea – the microscopic organisms known as 'plankton' – together provide food for the one billion supermen of the future? Is this, then, the prospect for our children's children in an overcrowded world?

A challenge

WITH REFERENCE to the warning by the British Weed Control Council of the dangers of using aircraft for spraying hormone weedkillers, see WORLD CROPS, **11**, 1959, 17 – we have been informed by a correspondent that the suggestion or implication that 'fixed wing aircraft using atomisers' have been used for spraying hormone weedkillers is not correct. He comments that the largest aerial spraying fleet in Britain has not undertaken any such operations, even on apparently isolated properties, because of the risks involved.

Looking ahead, we must hope that the manufacturers will be able to develop weedkillers which can be sprayed safely from the air, since there are many thousands of acres on which aircraft provide the only practical means of application.

Crop Protection and Pest Control

LEONARD HILL LTD. announce that the next *Crop Protection and Pest Control Exhibition*, organised by WORLD CROPS, will be held from Wednesday, 9 December, to Friday, 11 December, 1959, at the Seymour Hall, St. Marylebone, London, W.1.

This date has been chosen in response to many requests that the Exhibition should be held in the winter. In fact, this year's Exhibition will coincide with the Smithfield Show, when thousands of farmers will be in London.

The aim of the Exhibition is to cover all aspects of crop protection and pest control, including insecticides, weedkillers, fungicides, tree bands, fumigants, rodenticides, seed treatments, sprayers and applicators of all kinds, flame-guns, traps, insect repellants, bird repellants and alarms, timber preservatives and treatments, slug killers, disinfectants, cloches, bird netting, electric fencing, spraying by helicopter and fixed wing aircraft.

Further details can be obtained from the *Exhibition Organiser, World Crops, Leonard Hill House, Eden Street, London*, N.W.1.

Colombo plan aid

IT WILL COME as a surprise to most of our readers that about £1,785 million has been provided for co-operative economic development in certain countries in south and south-east Asia, since the inception of the Colombo Plan in 1950. The U.K. has contributed £123 million and the U.S.A. £1,428 million.

In addition, commercial companies and private investors have also provided capital, and according to the Seventh Annual Report of the Consultative Committee, there is fortunately a better appreciation of the importance of such capital aid in the initial stages of economic development. The foreign investor is now protected in some Asian countries against such risks as inconvertibility and expropriation.

If the economic development of a country is to progress steadily, the supply of technical experts is, nevertheless, as important as money, and furthermore, *skills must be developed at all levels*; if there is any lack of knowledge or artisan skills among the foremen and labourers, this can be as frustrating as a lack of money. The technical training of the people as a whole must keep pace with the development programme.

In agriculture, it is probably more important to teach people how to use their tractors and farm implements correctly, to keep them cleaned and oiled, and to carry out minor repairs, than it is to send selected

men of graduate class for special overseas training in advanced agricultural research only to find on their return that all the farm machinery is out of commission owing to gross neglect or because of some trifling fault, which could have been rectified in a few minutes by a properly-trained driver.

Technical training schools have now been established in a number of countries, and since 1950, training of various kinds has been given to more than 15,500 people from countries in this area. Britain alone has taken more than 2,000 trainees.

It was agreed at Singapore, three years ago, that the Colombo Plan should be extended to 30 June, 1961. Its future is to be considered by the Consultative Committee at a meeting in Indonesia this year.

Automation on the farm

A DEMONSTRATION of a driverless tractor was recently staged at the Reading University farm jointly by the Farm Mechanisation Department of the University and the Rural Electrification of the Electrical Development Association. A McCormick International tractor, fitted with special equipment, was made to carry out a routine carting operation. It went through a narrow gate, unloaded bales of fodder at predetermined intervals in the adjoining field, and even obeyed a traffic signal and stopped at the gate on its return.

It was explained to us by Mr. J. A. C. Gibb, lecturer in farm mechanisation at the University, that the tractor was not remote controlled by radio, but instead received its impulses from the magnetic field over a ground wire carrying low-voltage electric current.

' . . . and Miss Snooty here is dung spreading '

No form of human supervision was needed, as the operations were predetermined.

This, no doubt, is the beginning of the introduction of automation into agriculture. What visions does it conjure up? Perhaps cattle fed, washed, milked and treadmill-exercised, using the battery system, with special provision for the continuous removal of the dung and urine for continuous production of liquid manure, with the fields sprayed automatically according to the prevailing weather conditions – all without any human agency whatever.

In the field of remote control we have visions of an over-worked tea planter struggling with his never-ending official returns, while his three graduate assistants, Ramasamy, Perumal and Faliandy also seated in the office, direct three hillside tractors, fitted with mechanical tea pluckers, along the hedge-planted tea without another soul in sight.

Then the lumberman of tomorrow need no longer be a man of muscle. His work may be radio, magnetically or even thought-controlled. An automatic mobile power saw will bring down a giant of the forest; a driverless crawler tractor will seize it, drag it to the continuous processing sawmill and feed it into the production line to be converted into timber units.

Alistair Cooke, in his ' Letter from America ', recently predicted the coming of the 20-hour week as a result of more automation and the increasing use of nuclear energy. To fill 50 to 60 hours of unemployment will demand more entertainment and more and more sitting around. The many will, indeed, be served by the few; bureaucrats will continue to multiply until they outnumber by many times the few engaged in active production; the arms, legs, and, of course, the brains, of some 2,000 million drones will gradually atrophy, and thus world population will gradually be reduced by boredom and ill health.

Stale bread

THE OLDEST piece of bread in the world is to be found in the Swiss Landemuseum in Zürich. It was baked by a Stone Age baker some 6,000 years ago and was preserved by being accidentally dropped into the deep mud of a lake. It was found a few years ago by archaeologists in the dried-out lake bottom.

Nevertheless, the Egyptians get the credit for discovering leavening and for using the first real ovens. A round loaf of bread which was placed 3,400 years ago in the tomb of Princess Meryet-Amun is now to be found in a glass case in the Metropolitan Museum of Art in New York.

It was not until the Middle Ages that baking was divorced from milling. The bakers lived in the crowded medieval towns, while the millers established their water-powered mills and windmills in the surrounding countryside.

Problems of Rice Processing

Technical Advice and Assistance in Liberia

M. MANNI AND T. T. HOGAN
(*FAO, Rome*)

IN Liberia practically all rice is grown in small plots which have been previously cleared of bush by hand during the dry season, January–March, and then burned. The seed is broadcast between the stumps and fallen logs and is scratched in during the period May–July.

Harvesting and storage

The harvest begins in September and continues to December. Each stalk is cut about 8 in. below the base of the head, tied into bunches and laid out to dry on the stumps and logs. Later these bunches are collected and taken to dry in the loft of a thatched house over a smouldering fire.

This simple method of storage meets existing requirements, in that the moisture content is kept low enough to minimise deterioration and check insect infestation. When rice is needed, the bunches of paddy are removed from the loft, spread over the ground and threshed by flaying with sticks, assisted by the treading of many feet. Thus small pebbles and other extraneous material are unavoidably included in the product.

An example of FAO's activity in the field of technical advisory assistance is the work done between 1952 *and* 1953 *in Liberia, West Africa, in the planning and design of a pilot rice processing plant.*

Hulling and winnowing

The next operation is hand-pounding, the equipment used consisting of a hollowed-out log and a rounded pole. Small amounts of paddy are placed in the mortar and then pounded by women using the pole. When the husks are dislodged, the contents are removed and the husked rice and husks separated by winnowing in a rigid, slightly curved, shallow, woven basket. Any paddy remaining is returned to the mortar for additional pounding. The husked rice is then ready for sale, even though it contains several per cent. of unhusked paddy and varying amounts of dirt and pebbles.

However, before the rice is ready for cooking it is again pounded by the consumer and any remaining husk is thus removed, along with some more of the bran layers. Extraneous matter is removed in the washing before cooking.

Parboiling and parching

Parboiling is not a general practice in Liberia, most of the rice being marketed as grain. However, during early harvest, when the grain is high in moisture, either parboiling or parching is used as a means of reducing the water content.

The general practice of parboiling is as follows: a small iron pot is partially filled with paddy and water is added to about one-third the depth. Then the top is covered and the pot placed over a fire, where it remains until the water has all been steamed off. Afterwards the contents are spread on bamboo mats and dried in the sun until the grain is dry enough for pounding.

Parching is done by filling the pot about one-third full with paddy and heating it over a small fire. The contents are agitated by a paddle until it is dry enough for processing.

Threshing paddy by beating it with sticks

Treading the rice to separate the grains

Wooden pestles and mortars used for hulling the paddy Small amounts of paddy are placed in a mortar and pounded with the pole. The winnowing basket can also be seen

Fluctuations in supply

Normally paddy is processed on the farms and in the villages before being transported in varying amounts to established bulking centres, where traders purchase such offerings by weight on a more or less free-market basis. The traders bag and ship the rice to consuming areas, where it is either sold at once or stored in anticipation of rising prices. As might be expected, prices paid to producers are lowest during the flush season, gradually rising to a peak in the month of August, when rice is short.

Of recent years the Government has endeavoured to prevent seasonal scarcity by storing stocks in Monrovia and drawing on them at the tail end of the old crop movement when the supply is reduced. Sometimes shortages are not real, inasmuch as bunched paddy supplies may be quite ample in the villages, but due to either lack of labour, expectation of advancing prices, or the desire to maintain reserves, the producer does not offer his home-pounded rice.

Size of farms

One of the reasons operating against any increase in the size of farms is the practice of cultivating family-size holdings and hand-pounding the produce. In the past only such quantities have been produced which the women could conveniently home-pound. This has limited the size of farms to suit the family, or at most village operation.

For all these reasons insufficient rice is produced to meet domestic requirements, with the result that some eight to 12 thousand tons have to be imported annually into Liberia from abroad.

It seemed reasonable to assume that by erecting a mill to supplement existing small-scale milling, acreages would be expanded, with the farmers making available for purchase either all or surplus amounts. Also it was expected that the number of farms would be increased within the areas so served and it was felt too that the recovery of edible rice would be improved by mechanical means as opposed to the primitive mortar and pestle methods of working.

Pilot plant proposed

The Government of the Republic of Liberia accordingly requested and obtained from FAO the services of a rice processing expert to advise and assist in the establishment of a small rice processing pilot plant and the initiation of the subsequent milling operations.

The problem had to be considered in three aspects:

(1) Choice of site for pilot plant;
(2) Selection of equipment, and
(3) Design of structure.

In choosing the site for the mill the following factors were considered: (1) supplies of paddy; (2) transportation; (3) electric power; (4) repair shop; (5) labour; and (6) supervision. Several locations were investigated, all with certain advantages, but the Government Experiment Station at Suakoko seemed to fulfil most of the above requirements.

The Gbarnga district, which includes Suakoko, contains more rice farms than do the Sankwelle, Tappita and Salala districts. The site borders the main highway and lies south of the proposed road into the western province. On the station there is an adequate supply of electricity and a small machine shop, already functioning, which should be sufficient for minor repairs to equipment and

A hand-operated thresher introduced by FAO. The picture also shows the concrete sun-drying barbeque and, in the sheds in the background, the bunched paddy is dried over slow fires prior to threshing

machinery. Due to a past and present building programme in the Suakoko area a source of unskilled and semi-skilled personnel is assured.

Selection of equipment to fulfil specific needs was based upon the following points:

(1) Due to the methods employed in threshing, it is necessary to incorporate ample cleaning equipment to eliminate all extraneous materials, particularly stones.

(2) The Liberian palate is accustomed to a rice between the brown and under-milled stages; also due to current dietary deficiencies, it is desirable to conserve as many of the nutrients as possible. For these reasons it was decided to keep scouring to a minimum.

(3) Quality grading standards as generally adopted in many countries are not important in Liberia, so it seemed unnecessary to include other than simple classification. All rice that could be recovered, *i.e.* heads and chits, were to be packed together.

Equipment

In view of the rather unique requirements, it was believed that standard self-contained milling units would not be quite suitable and on the basis of the above-mentioned points, the following units were selected:

Thresher – a hand-powered unit to be situated outside the mill to thresh bunches, thereby increasing the availability of supplies of paddy.

Cleaner – a conventional type, including 3-sieve separation and double aspiration, the blast discharging into a cyclone collector.

Stoner – an inclined vibrating deck, giving air-float separation through differences in specific gravity.

Husker-aspirator – a rubber belt type of husker containing an internal aspirating box connected to an exhaust fan discharging into a cyclone collector, for the separation of husks from husked rice.

Scourer – a metal ribbed cylinder revolving against an adjustable blade, whereby the kernels are rubbed against each other. A fan is included exhausting into a cyclone collector.

Classifier – a 1-sieve vibrating screen made of perforated metal.

Logging – four elevators of metal construction, each 17 ft. in height, equipped with high-speed cups.

The flow chart (Fig. 1) indicates the sequence of operations in the pilot milling plant.

Building materials

Materials for the structure were chosen so as to utilise as much as possible those which were indigenous to the country.

Construction entirely of wood was ruled out because of conditions associated with tropical climate, *e.g.* heavy rainfall, probably future insect trouble and high cost of maintenance. Sun-dried clay blocks were considered to be lacking in strength and a combination of reinforced concrete floorings and floor slabs, concrete blocks walls, wooden trusses and asbestos sheeting for the roofs was finally adopted.

Layout and arrangements

In designing the layout of the plant, drying facilities were limited to a concrete slab, 50 ft. × 40 ft. wide, which should be sufficient inasmuch as most of the paddy would be suitable for milling and storage without sun-drying.

Consideration was given to the possibilities of bulk storage over in-sack warehousing. The former has distinct advantages, but due to lack of sufficient funds and other factors naturally associated with establishment of the first mill it was considered advisable to continue with sacks. Supplementary bulk storage can be added later when conditions warrant.

Control of insects by the use of insecticides was also considered and vetoed on the grounds that sound

(*Continued on page 90*)

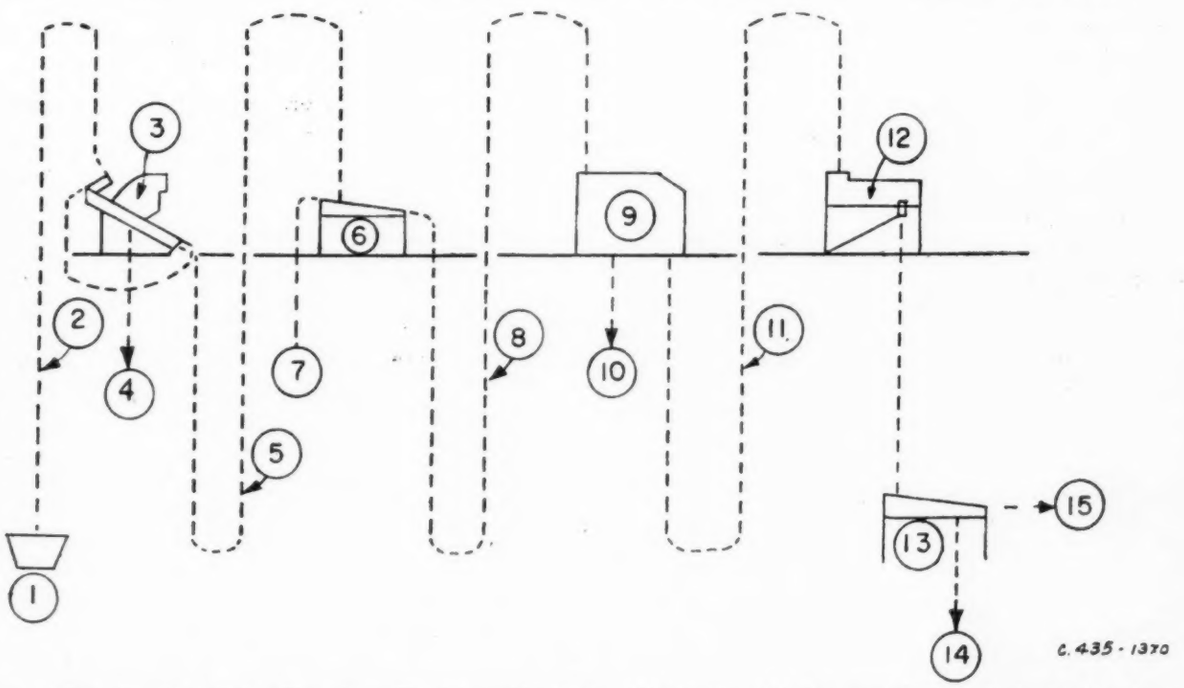

FIG. 1. *Flow diagram of the pilot rice mill:* (1) *paddy intake,* (2) *elevator,* (3) *cleaner,* (4) *refuse discharge,* (5) *elevator,* (6) *de-stoner,* (7) *foreign matter discharge,* (8) *elevator,* (9) *husker,* (10) *husk discharge,* (11) *elevator,* (12) *scourer,* (13) *classifier,* (14) *broken rice discharge,* (15) *clean rice delivery*

Grain Handling Equipment

From the National Association of Corn and Agricultural Merchants of Britain

In recent years the handling of grain in bulk has developed steadily in the main grain-growing areas of the world. These notes have been drawn up as a convenient guide for farmers, merchants, millers and other users of grain and all concerned in advising on or supplying this type of equipment.

IT is obviously essential that handling in bulk rather than in sacks should expedite the movement of grain, otherwise the installation of bulk handling equipment cannot be justified economically. It has been found in some cases that serious delays are caused to bulk vehicles and in others that only certain special vehicles can be used. These difficulties add to the cost of transporting grain, which is to the advantage of neither grower, merchant nor ultimate user; they can largely be avoided by the correct design of installations. It is therefore essential for anyone installing equipment to take into consideration not only the present requirements of his business and those collecting from or delivering to him, but also new machinery that may be introduced in the foreseeable future.

Corn and agricultural merchants are the link between farmers and the ultimate users of grain and the producers of animal feeding stuffs. The National Association of Corn and Agricultural Merchants has stated on behalf of its members that they are prepared to move grain and animal feeding stuffs in bulk or in sacks, according to the wishes of their customers. However, if bulk movement is going to develop, then it should be on well-thought-out lines, with some uniformity in the equipment used, so that all bulk vehicles can be loaded or unloaded with minimum delay.

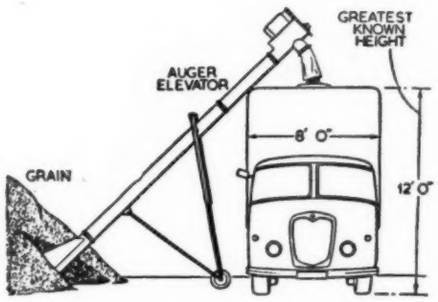

Fig. 1.
Top-loading by auger into a lorry 12 ft. high

Farm storage

Equipment for the bulk storage of grain on the farm will be supplied mainly by the manufacturers of bulk storage equipment, although some farmers may make their own bins, or have them made locally, using, where possible, materials of standard sizes. As the installation of this equipment will be arranged and paid for by the farmer, he is in the best position to encourage the manufacture of standard equipment, for he creates the demand.

The most important point for a farmer to consider is whether or not his grain production warrants the installation of bulk handling equipment, for on small farms it may often be more economical to keep and move grain in sacks. As a general guide, until a farmer's production justifies his purchase of a combine harvester, he will probably be ill-advised to incur any considerable expense on equipment for bulk handling or bulk storage.

Bulk grain vehicles

The largest road vehicle used in Britain for carrying grain in bulk is 12 ft. high and 8 ft. wide, plus the overhang of driving mirrors, but due allowance must be made where the road underneath or alongside bins is uneven. Room must also be available for vehicles to manoeuvre into position.

Facilities should be provided, where possible, for bulk vehicles to drive forward after loading or unloading, rather than having to back in or out. The turning circle will vary according to the make of vehicle and can be anything from 50 to 100 ft.

Where grain has to be collected by hauliers' or merchants' vehicles, it should be stored adjacent to a good road.

Loading rate

Bulk transport vehicles are more costly than those collecting bagged grain, and therefore facilities for loading and unloading should provide a higher rate of handling than if the grain is in sacks, which is about 10 tons per hour.

The aim should be to load at 20 tons per hour, or more if possible. This rate should not be difficult when loading from overhead or side delivery bins and should also be possible using elevator feed, especially if two or more elevators are available.

Table 1
Average weights of dry cereals

Grain	*lb. per cu. ft.*	*lb. per bushel*
Barley (No. 2 Canadian)	36	46
Oats.. ..	29½	38
Wheat ..	47	60

Bins need only be filled at a rate sufficient to enable them to be ready to load bulk vehicles to capacity immediately on arrival. Under normal conditions there should be plenty of time between collections to fill bins at a rate within the compass of elevating machinery used on the farm.

Bulk storage bins

Costs will be kept to a minimum if bins are made from materials of standard size. The minimum capacity should be 10 tons.

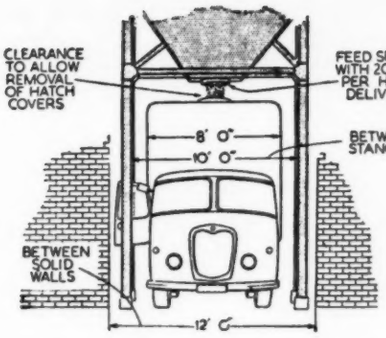

Fig. 2.
Top-loading by gravity from an overhead silo

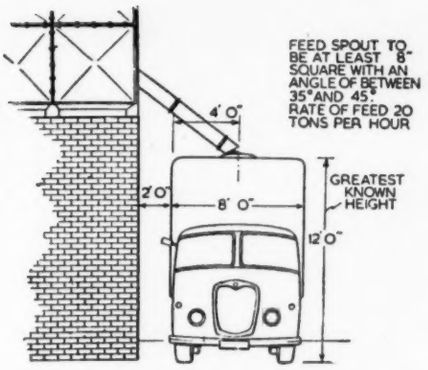
FEED SPOUT TO BE AT LEAST 8" SQUARE WITH AN ANGLE OF BETWEEN 35° AND 45°. RATE OF FEED 20 TONS PER HOUR
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Fig. 3.
Loading grain by chute from a side-delivery tank

Mechanical aids

It is up to the individual farmer to decide the best method of storing his grain in bulk, in the light of advice that can be obtained from technical experts and of his own practical knowledge. In many cases the erection of overhead delivery bins will be unnecessary. It will be possible to use existing storage bins, and the installation of elevators, augers, or blowers for loading bulk vehicles at the recommended rate of at least 20 tons per hour will be comparatively simple and inexpensive.

Where bulk vehicles are to be loaded by any of these means, the equipment used should be capable of loading the highest vehicle likely to call – 12 ft. As the vehicle loading hatches are usually along the centre line, the height of the elevator, depending upon the angle from the grain-collecting point to point of discharge, must be such that the grain will fall into the loading hatch (Fig. 1).

Overhead-delivery bins

The higher the bin, the greater the cost of installation and therefore overhead bins should be as near the ground as possible. There have already been occasions when bulk vehicles have arrived to collect grain and have had to be turned away unloaded because of inadequate height clearance. It is therefore up to farmers to decide upon a height that will accommodate all vehicles that are likely to collect in bulk from his overhead bins, and they are advised to contact their potential buyers as to the height of road vehicles that they may be using, now or in the future.

Regarding the width between supports of overhead bins, 10 ft. is considered to be sufficient if the bins are supported by stanchions, for the driver will be able to enter or leave his cab by parking the vehicle away from a stanchion. However, if a vehicle has to park between two solid walls, then a width of 12 ft. will be necessary (Fig. 2). Bin outlets and connecting chutes should be not less than 8 in. square.

Side-delivery bins

To meet special conditions, farmers may have to install bins where the vehicle has to be gravity-fed from a spout from the side of the bin (Fig. 3). When erecting such bins it should be remembered that (*a*) it is sometimes difficult to draw a vehicle within 2 ft. from the side of the bin, especially if there is a bad road or if the space available for manoeuvring is limited, (*b*) if the vehicle is filled through a centre hatch, then the hatch will be about 4 ft. from the side of the vehicle, (*c*) the angle of the chute should be at least 35° and preferably 45° to allow for the free flow of grain. At least 40° is necessary to ensure the free flow of oats and damp grain. Again, the rate of flow of the grain should be at least 20 tons per hour, and therefore the size of delivery chutes should be not less than 8 in. square.

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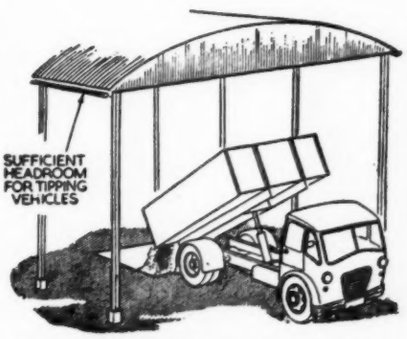


Fig. 4. Ample headroom is required for a tipping lorry

Delivery in bulk

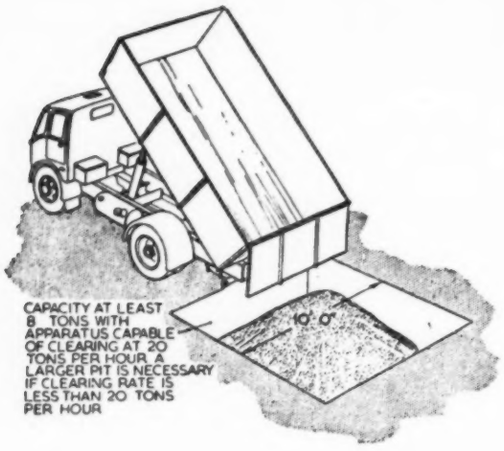
To minimise capital and operating costs, merchants delivering grain in bulk to shippers, millers, compounders, maltsters and brewers will always try to use standard vehicles which can be used for other purposes, such as carrying bagged grain, feeding stuffs, seeds etc., on the return journey or during periods when grain is not moving in bulk. Tipping vehicles are likely to be popular, especially as they can be hired from contractors at peak periods.

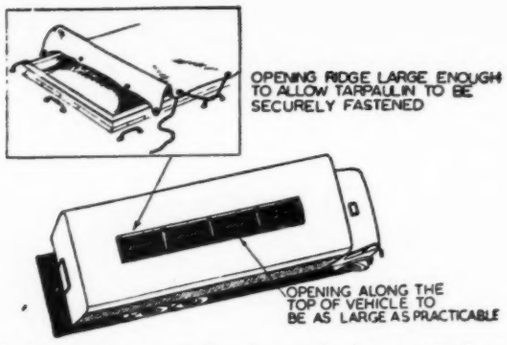
The main requirements of bulk grain vehicles are adequate protection from the weather, prevention of leakages and suitable discharge arrangements. If delivery in bulk is effected in tipping-vehicles, 25 ft. head-room may be required for tipping (Fig. 4).

The receiving pit should be as large as practicable so that vehicles can be off-loaded quickly. Its width should be at least 9 ft. but preferably 10 ft. and the capacity should be at least 8 tons, provided that the elevator or other apparatus to take the grain away has a minimum capacity of 20 tons per hour (Fig. 5). If the elevator has a lower delivery rate the pit should have a correspondingly increased capacity so that lorries carrying 12 tons or more can be unloaded without delay, and the pit cleared whilst the next vehicle is being manoeuvred into position.

If a small pit is used then the elevator capacity should be increased so that the pit is empty when the next vehicle is ready to off-load. The number of lorries to be cleared per day will determine the elevator capacity and pit size.

The installation of a sloped ramp for off-loading non-tipping vehicles may have practical difficulties because of the danger of spilling oil, petrol or water, but where it is possible, such


CAPACITY AT LEAST 8 TONS WITH APPARATUS CAPABLE OF CLEARING AT 20 TONS PER HOUR. A LARGER PIT IS NECESSARY IF CLEARING RATE IS LESS THAN 20 TONS PER HOUR
10' 0"


OPENING RIDGE LARGE ENOUGH TO ALLOW TARPAULIN TO BE SECURELY FASTENED
OPENING ALONG THE TOP OF VEHICLE TO BE AS LARGE AS PRACTICABLE

Left : *Fig. 5. Delivering grain into a pit from a tipping lorry*

Above : *Fig. 6. Roof hatch of a bulk grain transporting vehicle*

a ramp should be installed, for it is a relatively cheap and simple system for off-loading non-tipping vehicles or trailers. Consideration should always be given to installing mechanical aids for unloading this type of vehicle. Tipping gear affixed to vehicles is expensive and adds unnecessarily to the weight of the vehicle, and on many journeys serves no useful purpose, *e.g.* with bagged goods.

Delivery vehicles

Hauliers and merchants will naturally consider their particular requirements when ordering vehicles for carrying grain and animal feeding stuffs in bulk. The following points are recorded for information:

(*a*) Standard vehicles can be adapted for carrying grain in bulk, and where this can be done there is a considerable saving in capital cost.

(*b*) The highest known bulk loader is 12 ft. and as those installing bulk bins will have regard to this measurement, it will be advantageous if vehicle manufacturers can avoid exceeding this height.

(*c*) The width of vehicles is important because of the limited space into which vehicles sometimes have to enter. Sliding doors rather than those that open outwards would therefore be helpful.

(*d*) It has been suggested that an opening along the top of a bulk transporting vehicle would be better than a number of loading hatches, and would assist in loading the vehicle quickly and evenly (Fig. 6).

(*e*) It is considered a desirable development that vehicles delivering animal feeding stuffs in bulk should be so constructed that the apparatus which blows out the feed can be used also for sucking in grain which may be collected at the farm.

Problems of Rice Processing

(*Continued from page* 87)

warehousing practices, including good hygiene and regular turn-over of stocks, would be sufficient for the present.

Erection and operation

The building was finished in August 1953 and the installation of machinery completed on 12 December. The power unit was delivered on 29 December and was functioning on 24 March, 1954.

The first paddy and bunched rice deliveries were accepted on 11 December, 1953, and activities involving threshing, drying, bagging and stacking in warehouses were started at once.

Training and organisation

As far as the organisational side was concerned, the two local men assigned to the project were appointed to fellowships in Sierra Leone for a three-month period, where they acquired knowledge of storage, processing and marketing practices in a territory with similar conditions to those in their own country. One was appointed to the post of paddy rice buyer – the other will assume the duties of cashier and stores clerk.

The FAO expert, before leaving the country, worked out tables of figures to guide buying operations. Daily instructional classes were conducted over a period of six weeks on problems connected with mill operation and management.

M. Manni is Rural Industries Officer, FAO. T. T. Hogan is expert under FAO's Expanded Technical Assistance Programme.

REFERENCE

Hogan, T. T.: Report to the Government of Liberia on the Installation and Utilisation of a Rice Processing Pilot Plant. *FAO Report* No. 289, Rome, August 1954.

Technical News

Articles in the March issue of some of the other journals of the Leonard Hill Technical Group include the following:

Automation Progress. – 'Technological Progress in the Glass Industry' by D. K. Hill.

Dairy Engineering. – 'Boiler House Maintenance for Economical Performance' by W. G. Stack; 'Electropolishing, A New Method for Cleaning Stainless Steel Vessels' by C. W. E. Windsor-Richards.

Manufacturing Chemist. – 'Heating, Ventilating and Insulating in Chemical Factories'; 'Aerosol Insecticides'.

Paint Manufacture. – 'Preview of Oil and Colour Chemists' Association Technical Exhibition'; 'How Paints Stand up to Tropical Climates' by P. Whiteley, B.Sc., A.R.I.C.

Specimen copies of the above journals are available on application to Leonard Hill House, Eden Street, London, N.W.1.

Grain in International Trade

J. A. FREEMAN

(*Infestation Control Division, Ministry of Agriculture, Fisheries and Food*)

Morocco. Sampling grain for examination prior to export

There is always the risk that grain may be damaged by development of infestation during carriage by sea. For these and other reasons the prevention and control of infestation should be regarded as essential through the whole process from production to consumption.

Argentina. Compulsory treatment of railway wagons with DDT/BHC dust

GRAIN and grain products are liable to attack by pests in all parts of the world. In temperate countries, attack usually starts after the crops have been put into store. In warmer climates, storage insects fly into the fields and attack the growing crop. The rice weevil, *Calandra oryzae*, is regarded as a major field pest of maize in the south-eastern states of the U.S.A., where it causes an annual loss of 25% of the crop.

Storage pests breed more rapidly and cause more damage the warmer the climate. Extreme climatic conditions are unfavourable for all except a few species. Thus the khapra beetle, *Trogoderma granarium*, breeds readily at the high temperatures found in the surface layers of dry grain exposed to the sun in the tropics;[1] the rusty grain beetle, *Cryptolestes ferrugineus*, which breeds in the germ and can cause grain to heat, can survive the winter in unheated farm buildings to the northern limit of grain growing in Canada.

Infestation control

The need to protect grain from attack by insects as distinct from control of outbreaks is particularly important in countries like Canada and the U.S.A., where grain is marketed according to a uniform official grading system in which living insects and the damage done by them are grading factors.

In Canada, all western grain, *i.e.* that produced in the Prairie Provinces, is graded by Federal Government inspectors at certain major traffic points and is finally check-inspected at time of export. In the U.S.A., grading is carried out by licensed grain graders acting under the guidance of Federal Government officials. In Canada, grain once graded must be binned and handled separately according to grade, and hence grain once graded maintains its identity and needs only check inspections later.

In the U.S.A. binning to grade is not compulsory and grain is graded afresh each time it enters and leaves a terminal elevator. Therefore one lot of grain may be graded several times before it is finally graded into an ocean freighter.

In Canada any grain in which insects are found, even in the smallest numbers, is regarded as ungraded and as such cannot be taken into a terminal elevator until it has been treated and resubmitted for grading.[2] Similarly infested grain in a terminal elevator cannot be delivered. In the U.S.A. the grading system[3, 4] allows a tolerance of insect infestation, generally one adult weevil per kg. of sample.[5] The grade certificate of any grain having more than the tolerance is endorsed ' weevily ', and this word forms part of the grade designation, *e.g.* No. 2 Dark Hard Winter Wheat, weevily. Within the U.S.A. grain and its products for human consumption must also comply with the standards laid down by the Food and Drug Administration, under which flour, in particular, must not contain more than a very small proportion of microscopic fragments of insects.

In both Canada and the U.S.A. grain for export is finally inspected or graded as it runs into the ship's holds. It is therefore important to prevent grain being infested by insects remaining in the holds from previous voyages.

Where grain is sold for export on a ' fair average quality ' (F.A.Q.) basis, as from Argentina and Australia, infestation does not normally enter into the commercial determination of quality, except indirectly to the extent that insect damage affects bushel weight and dust content.

For purchase of grain in Argentina by the official grain organisation (Junta Nacional de Granos), and for resale to grain exporting firms, there is a generally accepted tolerance of 10 ' weevils ' per kg. Grain exported from Morocco may have no more than two weevils per kg. All grain exported from Brazil and Algeria must be free from living insects and this is ensured by compulsory fumigation.

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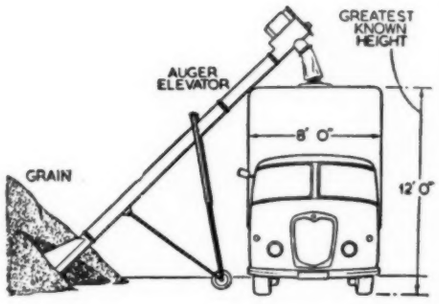

Fig. 1.
Top-loading by auger into a lorry 12 ft. high

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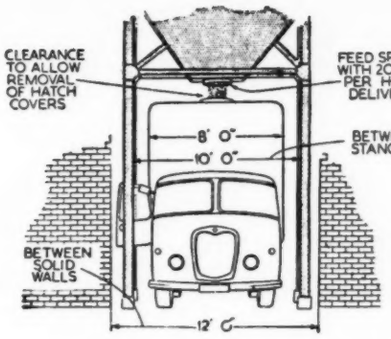
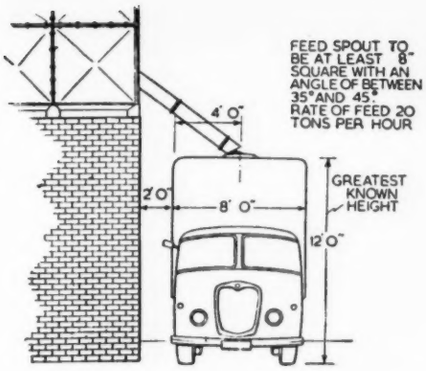


Fig. 2. Top-loading by gravity from an overhead silo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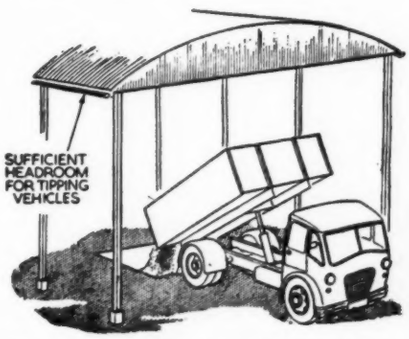

Fig. 4. Ample headroom is required for a tipping lorry

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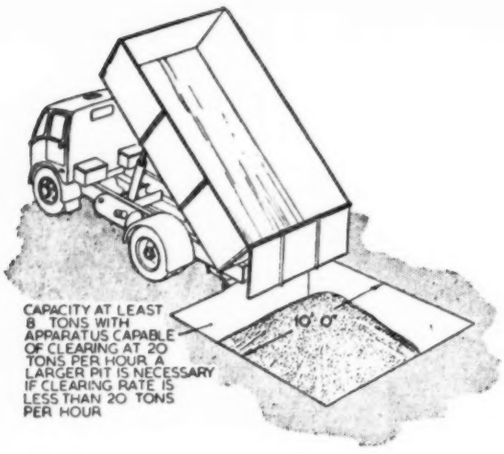
The installation of a sloped ramp for off-loading non-tipping vehicles may have practical difficulties because of the danger of spilling oil, petrol or water, but where it is possible, such


CAPACITY AT LEAST 8 TONS WITH APPARATUS CAPABLE OF CLEARING AT 20 TONS PER HOUR. A LARGER PIT IS NECESSARY IF CLEARING RATE IS LESS THAN 20 TONS PER HOUR
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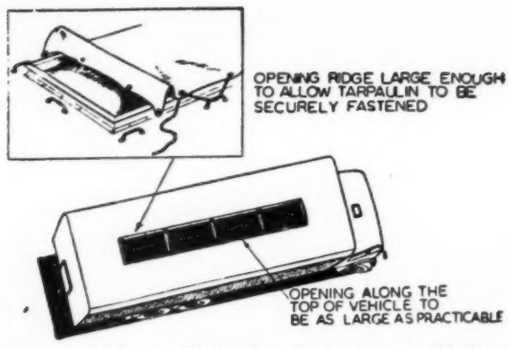

OPENING RIDGE LARGE ENOUGH TO ALLOW TARPAULIN TO BE SECURELY FASTENED
OPENING ALONG THE TOP OF VEHICLE TO BE AS LARGE AS PRACTICABLE

Left : *Fig. 5. Delivering grain into a pit from a tipping lorry*

Above : *Fig. 6. Roof hatch of a bulk grain transporting vehicle*

a ramp should be installed, for it is a relatively cheap and simple system for off-loading non-tipping vehicles or trailers. Consideration should always be given to installing mechanical aids for unloading this type of vehicle. Tipping gear affixed to vehicles is expensive and adds unnecessarily to the weight of the vehicle, and on many journeys serves no useful purpose, *e.g.* with bagged goods.

Delivery vehicles

Hauliers and merchants will naturally consider their particular requirements when ordering vehicles for carrying grain and animal feeding stuffs in bulk. The following points are recorded for information:

(*a*) Standard vehicles can be adapted for carrying grain in bulk, and where this can be done there is a considerable saving in capital cost.

(*b*) The highest known bulk loader is 12 ft. and as those installing bulk bins will have regard to this measurement, it will be advantageous if vehicle manufacturers can avoid exceeding this height.

(*c*) The width of vehicles is important because of the limited space into which vehicles sometimes have to enter. Sliding doors rather than those that open outwards would therefore be helpful.

(*d*) It has been suggested that an opening along the top of a bulk transporting vehicle would be better than a number of loading hatches, and would assist in loading the vehicle quickly and evenly (Fig. 6).

(*e*) It is considered a desirable development that vehicles delivering animal feeding stuffs in bulk should be so constructed that the apparatus which blows out the feed can be used also for sucking in grain which may be collected at the farm.

Problems of Rice Processing

(*Continued from page* 87)

warehousing practices, including good hygiene and regular turn-over of stocks, would be sufficient for the present.

Erection and operation

The building was finished in August 1953 and the installation of machinery completed on 12 December. The power unit was delivered on 29 December and was functioning on 24 March, 1954.

The first paddy and bunched rice deliveries were accepted on 11 December, 1953, and activities involving threshing, drying, bagging and stacking in warehouses were started at once.

Training and organisation

As far as the organisational side was concerned, the two local men assigned to the project were appointed to fellowships in Sierra Leone for a three-month period, where they acquired knowledge of storage, processing and marketing practices in a territory with similar conditions to those in their own country. One was appointed to the post of paddy rice buyer – the other will assume the duties of cashier and stores clerk.

The FAO expert, before leaving the country, worked out tables of figures to guide buying operations. Daily instructional classes were conducted over a period of six weeks on problems connected with mill operation and management.

M. Manni is Rural Industries Officer, FAO. T. T. Hogan is expert under FAO's Expanded Technical Assistance Programme.

REFERENCE

Hogan, T. T.: Report to the Government of Liberia on the Installation and Utilisation of a Rice Processing Pilot Plant. *FAO Report* No. 289, Rome, August 1954.

Technical News

Articles in the March issue of some of the other journals of the Leonard Hill Technical Group include the following:

Automation Progress. – 'Technological Progress in the Glass Industry' by D. K. Hill.

Dairy Engineering. – 'Boiler House Maintenance for Economical Performance' by W. G. Stack; 'Electropolishing, A New Method for Cleaning Stainless Steel Vessels' by C. W. E. Windsor-Richards.

Manufacturing Chemist. – 'Heating, Ventilating and Insulating in Chemical Factories'; 'Aerosol Insecticides'.

Paint Manufacture. – 'Preview of Oil and Colour Chemists' Association Technical Exhibition'; 'How Paints Stand up to Tropical Climates' by P. Whiteley, B.Sc., A.R.I.C.

Specimen copies of the above journals are available on application to Leonard Hill House, Eden Street, London, N.W.1.

Grain in International Trade

J. A. FREEMAN

(*Infestation Control Division, Ministry of Agriculture, Fisheries and Food*)

Morocco. Sampling grain for examination prior to export

There is always the risk that grain may be damaged by development of infestation during carriage by sea. For these and other reasons the prevention and control of infestation should be regarded as essential through the whole process from production to consumption.

Argentina. Compulsory treatment of railway wagons with DDT/BHC dust

GRAIN and grain products are liable to attack by pests in all parts of the world. In temperate countries, attack usually starts after the crops have been put into store. In warmer climates, storage insects fly into the fields and attack the growing crop. The rice weevil, *Calandra oryzae*, is regarded as a major field pest of maize in the south-eastern states of the U.S.A., where it causes an annual loss of 25% of the crop.

Storage pests breed more rapidly and cause more damage the warmer the climate. Extreme climatic conditions are unfavourable for all except a few species. Thus the khapra beetle, *Trogoderma granarium*, breeds readily at the high temperatures found in the surface layers of dry grain exposed to the sun in the tropics;[1] the rusty grain beetle, *Cryptolestes ferrugineus*, which breeds in the germ and can cause grain to heat, can survive the winter in unheated farm buildings to the northern limit of grain growing in Canada.

Infestation control

The need to protect grain from attack by insects as distinct from control of outbreaks is particularly important in countries like Canada and the U.S.A., where grain is marketed according to a uniform official grading system in which living insects and the damage done by them are grading factors.

In Canada, all western grain, *i.e.* that produced in the Prairie Provinces, is graded by Federal Government inspectors at certain major traffic points and is finally check-inspected at time of export. In the U.S.A., grading is carried out by licensed grain graders acting under the guidance of Federal Government officials. In Canada, grain once graded must be binned and handled separately according to grade, and hence grain once graded maintains its identity and needs only check inspections later.

In the U.S.A. binning to grade is not compulsory and grain is graded afresh each time it enters and leaves a terminal elevator. Therefore one lot of grain may be graded several times before it is finally graded into an ocean freighter.

In Canada any grain in which insects are found, even in the smallest numbers, is regarded as ungraded and as such cannot be taken into a terminal elevator until it has been treated and resubmitted for grading.[2] Similarly infested grain in a terminal elevator cannot be delivered. In the U.S.A. the grading system[3, 4] allows a tolerance of insect infestation, generally one adult weevil per kg. of sample.[5] The grade certificate of any grain having more than the tolerance is endorsed 'weevily', and this word forms part of the grade designation, *e.g.* No. 2 Dark Hard Winter Wheat, weevily. Within the U.S.A. grain and its products for human consumption must also comply with the standards laid down by the Food and Drug Administration, under which flour, in particular, must not contain more than a very small proportion of microscopic fragments of insects.

In both Canada and the U.S.A. grain for export is finally inspected or graded as it runs into the ship's holds. It is therefore important to prevent grain being infested by insects remaining in the holds from previous voyages.

Where grain is sold for export on a 'fair average quality' (F.A.Q.) basis, as from Argentina and Australia, infestation does not normally enter into the commercial determination of quality, except indirectly to the extent that insect damage affects bushel weight and dust content.

For purchase of grain in Argentina by the official grain organisation (Junta Nacional de Granos), and for resale to grain exporting firms, there is a generally accepted tolerance of 10 'weevils' per kg. Grain exported from Morocco may have no more than two weevils per kg. All grain exported from Brazil and Algeria must be free from living insects and this is ensured by compulsory fumigation.

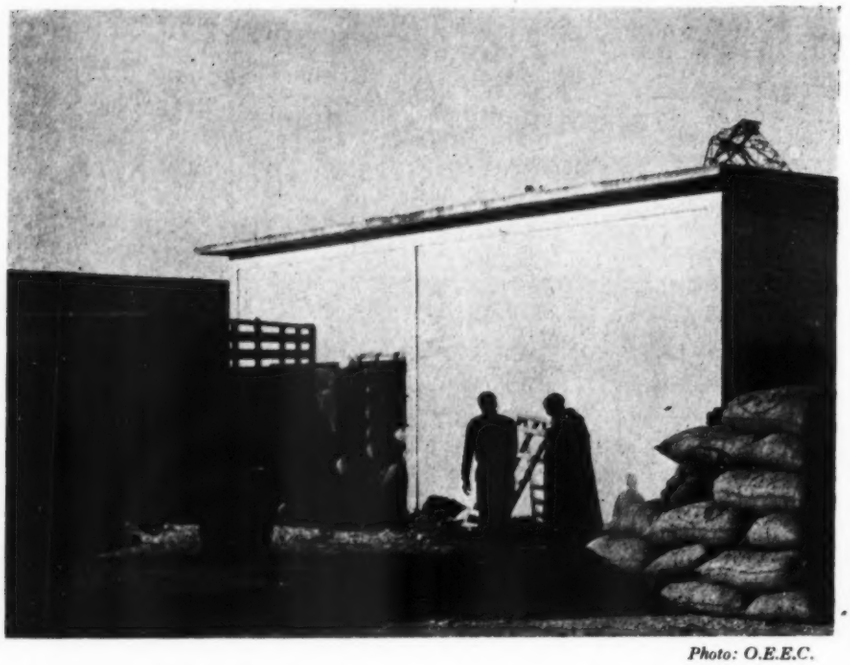


Photo: O.E.E.C.

Morocco. One of the fumigation chambers in the port area of Safi, with grain awaiting treatment prior to export in the foreground

Commercial fumigation of grain

Some countries rely mainly on fumigation, whilst others rely on residual sprays and dusts. Thus, for example, unlike in the United States and Canada, little routine fumigation is carried out in Argentina and Uruguay, where bagged grain is regularly treated with DDT/BHC dusts. The same treatment is used for empty transport vehicles. Similar dusting with lindane dusts is carried out in North Africa as a supplement to fumigation.

Insecticidal treatment of grain in transit in the U.S.A. and Canada – as compared with treatment in long- or medium-term storage – is normally done by elevator operators or millers themselves, using halogenated hydrocarbon mixtures.

To avoid bringing infested grain into elevators much treatment is done in railway box cars which have carried the grain. Steel box cars, with wooden floors, form satisfactory fumigation chambers. The standard box car holds some 50 tons of wheat. Treatment is usually by halogenated hydrocarbon mixtures for periods of 24–28 hours. The fumigant is poured on the surface of the grain.

For treatment in grain elevators, fumigants, usually mixtures of halogenated hydrocarbons, are generally applied to grain running into the bins, either directly into the grain stream, or on to the conveyor band, or at intervals as the grain fills the bins. Some elevators use carbon tetrachloride alone. A few use calcium cyanide, but it is not used in Canada because grain to which lime has been added is liable to be severely downgraded.

Local treatments may be necessary in elevators in Canada and the United States for control of surface infestations of *Ephestia elutella* and *Plodia interpunctella* in the tops of silo bins or in bulk stores or in store ships. This may be done by local application of chlorinated hydrocarbons, by synergised pyrethrin emulsion or malathion sprays or dusts (the latter in Canada only), by mineral oil sprays or by fumigation with chloropicrin.

Fumigation of stocks in U.S.A.

Long-term storage in the U.S.A. has presented a different problem because of the need to kill immature stages as well as adults. The large quantities of grain held in individual piles in some places has also made effective control essential.

Grain protectants are used to a limited extent for the treatment of grain going into long-term storage. Grain protectant dusts have not proved very acceptable except for farm use, but large-scale applications have been made using water emulsion or solvent sprays based on pyrethrins-piperonyl butoxide. The rate of application, normally 4 gal. of emulsion (20% piperonyl butoxide and 0.2% pyrethrins) or 2 gal. of solvent spray per 1,000 bushels of grain, gives a dosage of about 12.5 p.p.m. of piperonyl butoxide and 1.25 p.p.m. of pyrethrins. Greater dosages are necessary as moisture content of the grain increases, especially over 13%, but the effect differs from species to species.

The standard treatment for grain in reserve stocks, whether 1,000- or 3,000-bushel bins, large bulk stores or in ships, has been fumigation with halogenated hydrocarbon mixtures at the rate of 3–6 gal. per 1,000 bushels, according to formulation, for a minimum exposure period of 10 days. It has been found essential, particularly in ships, to ensure an even distribution of fumigant over the surface.

Conventional silos, flat stores, oil tanks and ships used for grain storage have been fitted with air ducts and blowers for cooling the grain by blowing air through it so as to prevent condensation due to temperature gradients set up in the grain mass. This apparatus has been used in various ways for the fumigation of grain with methyl bromide. Circulatory fumigation has been done in conventional silos by fitting an external return duct in oil tanks and ships and fumigant has been blown through or sucked into bulk grain stored on floors. Fumigant has also been blown into silos from the bottom by air-blowing apparatus without a complete circulatory cycle.

The dosages of methyl bromide used for such treatments have been 32–64 oz. per 1,000 cu. ft. for from 24 to 72 hours. Control of infestation in the huge tent-covered pyramids of wheat, each pyramid consisting of some 35,000 tons, was done by adding calcium cyanide at time of loading. A watch was kept on the condition of the grain by regular temperature records from 1,100 points in each bulk. The dosage rate was 10 lb. per 1,000 bushels.

Methods in other countries

The practice of circulatory fumigation has been established in Europe and in Brazil for many years. Many silos in Turkey have several fumigation bins; recently built-in silos in Tunisia, Algeria and Morocco have some or all

bins, so fitted. It has been standard practice in Tunisia since 1936, and the apparatus used for circulation there is of simple but effective design and construction.

Methyl bromide is mainly used, but not to the exclusion of methyl formate (Areginal) or carbon tetrachloride. The dosage of methyl bromide used in the silos in Tunisia is 20 oz. per 1,000 cu. ft. for an indefinite exposure, since no airing is carried out. Treatments are generally repeated every three months. The dosage of carbon tetrachloride, which is used almost as much as methyl bromide, is 1–1¼ gal. per 1,000 cu. ft. for an indefinite period.

Other fumigants used in Mediterranean grain-exporting countries include hydrogen phosphide, generated by reaction between intergranular moisture and aluminium phosphide made up in special tablets inserted into grain at a rate of 60 g. of tablets per ton for an exposure period of 72 hours. This method has been extensively used in Turkey and has enabled the Turkish wheat office to fulfil its guarantee of freedom from weevils in export wheat.

In Morocco, where grain is moved and stored in bags, it is found essential to carry out regular fumigation to maintain stocks in good condition. All grain stores have atmospheric fumigation chambers where carbon disulphide is the common fumigant, used at a dosage of 200 g./cu. m. for 48 hours' exposure. In Algeria there has been some use of propylene oxide for fumigation of grain in silos. The liquid is added to the grain surface at a rate of 50 g./cu. m. for an indefinite exposure period. The system used is that developed by Mallet & Lepigre of released vacuum, with simultaneous admission of air and fumigant. Cereals are seldom treated by vacuum in North Africa, but this is done regularly in Brazil in the vacuum fumigation plant in Rio de Janeiro. There grain is treated with methyl bromide at 25 g. of methyl bromide per cu m. for a period of sustained vacuum of 6–12 hours.

Treatment of ships

The treatment of the empty holds of ships has already been mentioned. In Canada fumigation with methyl bromide (at from 16–32 oz. per 1,000 cu. ft. for 10–12 hours) is generally required for anything other than a very local infestation, for which spraying with a pyrethrins-based spray is permitted. In the U.S.A. fumigation (HCN at 8–16 oz., 1,000 cu. ft., minimum 8 hours) is exceptional and the common treatment is spraying with emulsion or light oil sprays based on pyrethrins-piperonyl butoxide and methoxychlor. It may be noted here that spraying of empty holds is seldom, if ever, used in U.K. ships and ports, where smoke generators (DDT and lindane) have been found to be as effective and easier in use.

Treatment of ships which are normally loaded with bulk or bagged grain was first developed in Brazil during 1946. The fumigant used is methyl bromide, released into the free space above the cargo at a dosage of 35–43 g. per cu. m. for 30–36 hours' exposure. The results, as judged by inspection of cargoes arriving in the U.K., are not as good as when goods are fumigated in silos or fumigation chambers on shore.

Commercial treatments of export bulk grain in ships have been carried out in ports in the U.S.A., Turkey and Pakistan, using halogenated hydrocarbons poured into the square of the hatch, and good results have been claimed, although experience of treatment of U.S.A. storage ships would indicate that this would not be expected. In Chilean ports, cargoes of bulk grain are treated with hydrogen cyanide for control of Angoumois grain moth, *Sitotroga cerealella*.

Conclusions

In this survey of methods of infestation control used in grain exporting countries, stress has been laid on the fact that a major factor in causing control measures to be carried out on a wide scale has been the existence of official quality standards for grain.

These controls have reduced the extent of the problem for the importing countries, but these measures appear to have been taken primarily on the initiative of the exporters rather than as the result of any direct action by importing countries. These have for many years accepted insects and mites as something inseparable from the commodity and therefore not a matter which can be reasonably objected to. During recent years, however, this attitude has been disappearing and more pressure is being put on exporters to send goods free from infestation.

Sampling wheat for final certificate as it passes into the hold of the ship

REFERENCES

1. Oxley, T. A. (1950): 'Grain Storage in East and Central Africa', *Colon. Res. Pub.* No. 5, 18, H.M.S.O., London.
2. Canada Grain Act, 1930, Art. 126.
3. Handbook of Official Grain Standards of the United States, U.S. Dept. Agric., 1956, Misc. Pub. 722, 16.
4. Combs, W. B., and Smith, F. G. (1950): 'Grain Grading Primer', U.S. Dept. Agric., 1950, Misc. Pub. 325, p. 49.
5. Grain Inspection Manual, U.S. Dept. Agric., 1952, Grain Branch Instruction No. 918 (GR)-6, 23–25.

Abstract of a paper read before the Pesticides Group of the Society of Chemical Industry.

The maize stands higher than a horseman at Ceacu

Maize in Rumania

Improved Seed and New Farming Methods

B. HUGHES

Rumania is predominantly an agricultural country and maize is the leading crop. Herodotus recounts how the corn stood higher than a horseman, and the army of Alexander the Great had to cut a way through the cornfields with their spears.

ALTHOUGH the number of agricultural workers has decreased by 5% since the war, they still represent 75% of Rumania's population, and agriculture is therefore of prime importance. Maize, the chief cereal crop, occupies about 39% of the arable land. It has, indeed, been grown for 250 years, but its cultivation was extremely primitive and uneconomic until the early 1950s, when hybrid maize was first introduced.

In 1957 a Research Institute, devoted entirely to maize cultivation, was established at Fondulea, in the Baneasa area. It is under the direction of Prof. N. Giosan, comes under the Ministry of Agriculture and has five experimental stations in various natural regions – Bucharest, Timisoara, Cluj, Jassy and Craiova.

The purpose of the Institute is to experiment with and produce hybrid maize strains which are individually suited to the different natural zones in Rumania. In addition to this, the Institute tests new types of mechanical irrigation equipment, so that districts now prone to drought can grow maize. Attention is also being paid to the utilisation of maize as food and fodder and as an industrial raw material.

Plans for improvement

Maize is grown chiefly in the warmer south. The average yield has doubled since 1938, but it is still well below the U.S.A. figure. By 1960 the Rumanians hope to sow 4 million ha. with hybrid seed and harvest 10 million tons. This is estimated to be 50% more than her internal needs, and the Government intends to export the surplus. This ambitious target has only been possible since the introduction of hybrid maize seed in 1954–55.

As in other countries, the larger farms show the highest productivity for the lowest cost, and since a peasant holding may be as little as 2–3 ha., it is not surprising that maize is a crop limited to the bigger farms, in particular the State collectives. They cover about 700,000 ha. of arable land at the present time, but the five-year plan for agriculture, now in operation, hopes for another 300,000 ha. to come within the collective farm system by 1960. Midway between the peasant smallholdings and the collectives are the co-operatives, made up of groups of wealthier peasants. Here the farmers will join forces for jobs like ploughing and make contracts with some of the 236 machine and tractor stations for harvesting.

In 1955 the Rumanians sent a trade delegation to Iowa, U.S.A., to buy improved strains of hybrid maize, study mechanical methods of cultivation and buy specialised machinery. The following year, 1956, two American maize experts visited Rumania to see the new machines in action and advise on their operation under Rumanian conditions.

They found several differences between Rumanian and American practice. For instance, the Rumanians were sowing 25 kg. maize seed per ha., where the Iowa figure was 8 kg. However, when the mechanical hoeing was completed, so many plants had been dug up in the Rumanian fields that in the end both countries had about the same number of plants growing to maturity.

Research

In 1956 a conference of agricultural scientists and practical working farmers was held in Bucharest to discuss maize cultivation, and following this a group of specialists, led by Prof. Giosan, attended an international conference on maize cultivation and the production of hybrid maize, held in Russia from 28 March to 2 April, 1956. As a result of this exchange of ideas the Rumanians began to experiment with a variety of strains of hybrid maize suited to their different soils and climatic conditions.

Mechanisation and irrigation

Hand in hand with its experimental programme went the drive for more mechanisation, the State tractor factories being urged to increase production. New hydro-electric schemes, in particular that at Bicaz, are bringing large stretches of dry land under irrigation. Yields on irrigated land are up to 230% higher than on the same land before irrigation. The 1957 figure for maize grown under irrigation was 10,000 ha., and this figure is bound to increase annually. One of the provisions of the five-year plan relating to maize is that by 1960 each collective farm must have selected and cultivated at least one 100-ha. lot planted with irrigated maize. Double hybrid maize was sown on about 100,000 ha. in the spring of 1958.

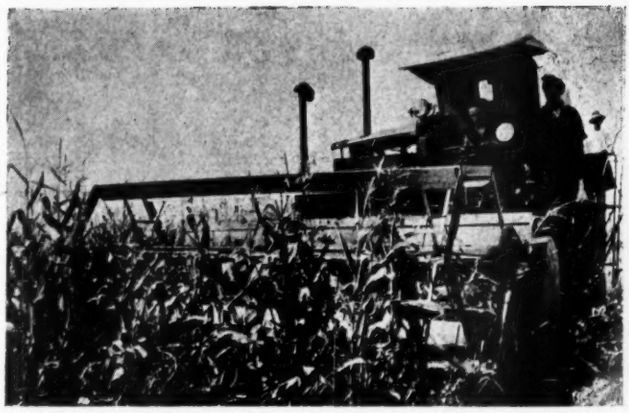
Hybrid maize

The work of the Research Institute for Maize Culture, even within the short period of its existence, certainly suggests that the double hybrid maize is the type best suited to Rumanian conditions. Yields have increased from 30–105% over various indigenous strains of maize. The double hybrids,

Pioneer 345 and 301, for instance, produced a yield of 7,500–8,000 kg. per ha. at the experimental station of Simnic, Craiova, compared with 3,800 kg. per ha. produced there by the Rumanian maize, Studina.

Different hybrids give varying results according to district. In Rumania's hill regions it was found that Warwick 260 and 276 and Wisconsin 270, 275 and 279 gave the best results. For the main steppe region Pioneer 383, 345 and 301, also K8-5, were best suited. KA-4, Wisconsin 355-A and Warwick 303 were preferred for the Moldavian wood and steppe lands. The red-brown wood-soils of the Muntenian steppe showed best results with Wisconsin 355-A, KS-5, Pioneer 383 and WIR-42. In the plains of Banat and Bihar the most productive hybrids experimented with were Warwick 401, Wisconsin 541-AA, Wisconsin 525 and Pioneer 341.

Some experimental stations and State collectives tried out various hybrids under drought conditions and Pioneer 301 and 345, Wisconsin 355 and KA-4 were outstandingly superior to the Rumanian selected seed, in some cases as much as 100%. In irrigated areas Pioneer 345 was preferred.



Another type of harvester operating on the State Collective Farm at Aradul Nou in the Arad region. There will be one million acres farmed collectively by 1960

Cultivation methods

The Maize Institute has been investigating different types of hybrids, crossing some strains, and using altogether more than 1,000 tons of double hybrid seed in its trials. The research teams working at the Institute and at the experimental stations have to undertake comprehensive cultivation in order to narrow down the best methods for particular areas. Later, the results of their investigations will be passed to the State collective farms as instructions on the best way to grow maize.

The highest yields were obtained on land which was harrowed in the spring and mechanically weeded before sowing. At the appearance of the first, and then the second pair of leaves, the land was harrowed again and weeded mechanically three times in all before harvesting.

So far as chemical fertilisers were concerned, the Institute decided that, provided the land is carefully harrowed beforehand, double hybrid maize is almost equally as productive on degraded chernozems as on chernozems and alluvial soils. On red-brown, red-brown podzol and on wood-brown soils it was found that double hybrid maize did better if organic and nitrate fertilisers were used. The yields were fairly good with phosphatic fertilisers, but the addition of potassic fertilisers seemed to make little or no difference.

In the choice of machinery for maize cultivation, the Institute considered that the disk-harrow for working the land in spring, for summer sowing, was the best. The rotary hoe was used as soon as the plants could be seen and the tractor-suspended cultivator (UTOS-26 tractor) was employed for weeding. The Institute also designed a double-furrow opener machine to sow maize in double rows.

Pests and diseases

Work on the various diseases common to maize plants has been carried out at the Institute, and research done on all the strains used in Rumania, according to their reaction to diseases in different regions of the country. The fungus, *Ustilago zeae*, producing the common maize-cockle, and the fungus, *Helminthosporium turcicum*, producing a leaf withering, have been carefully studied.

Maize weevil, the *Tanymecus dilaticollis*, has been found to be noxious until the month of June, and the maize-driller, *Pyreusta nubilalis*, has also been troublesome, with 10% of its grubs reaching maturity by the end of July, thus ensuring a second generation.

Weed control is not being forgotten and an experimental area of about 100,000 ha. was devoted to weed control by chemical means during the past year. This is a side of agricultural improvement that is certainly likely to develop, for the Rumanian chemical industry is now expanding and will be able to meet all the needs of agriculture.

The Maize Institute has maintained a continuous exchange of seeds and information with other similar agricultural institutes, in Russia and other European countries, and also with organisations in the U.S.A. and Canada. Maize stands high in the list of agricultural priorities; more mechanisation is promised and irrigation is expected to be extended to the co-operatives, as well as the collectives, between now and 1960.

A combine harvester in operation on the Secueni State Farm in the Jassy region. It cuts the corn, removes the cobs and binds the sheaves

Farm Grain Stores

Design and Operation of Storage Driers

The progressive increase in the use of combine harvesters in recent years has speeded the harvest and made it necessary for the farmer to dry and store his grain.

Photo: U.S.I.S.

Corn left to dry out in stook. This is not satisfactory where the climate is damp and uncertain

TODAY something like half the total cereal crop becomes available within eight weeks of a normal harvest. There is a pressure to sell and inevitably the price falls in the early autumn. Thus the farmer is being forced to provide some storage on the farm, but capital investment in corn driers and storage can be covered by savings in harvest costs and increased prices for grain sold later in the year.

Where the corn is to be consumed as stock feed, the necessity for storage is even greater, for there can be no argument that it is uneconomic to sell feed corn during harvest which must be bought back again later in the year, when the price will have to cover the normal seasonal price rise, and also the merchant's costs and profits.

Natural drying

Thus for the majority of large and small farms, where corn will have to be fed or held until fair prices can be obtained, storage is essential, and if storage is to be erected then it is obvious that this might as well also be used for drying the corn.

One objection to in-bin drying is the time taken; it cannot be hurried, but it is difficult to think of occasions when this is of importance.

The principle of ventilated bin drying is based on the fact that the moisture content of all grain tends to come into balance with that of the surrounding air. If water-saturated air flows over corn, it will make it wetter; conversely, dry air will dry it.

If grain is to be stored safely in bulk through the winter its moisture content must be reduced to below 14%. To dry grain to this moisture content, the surrounding air must have a relative humidity of just under 60%. This occurs only in dry weather, so that the air used for ventilating the grain needs to be heated.

Hot air drying

It has been found that, no matter how bad the weather, suitable drying conditions can be obtained by heating the air for grain drying to not more than 10°F above that of the air at the fan intake. Fans are necessary to blow the air through the corn in the silo and if these are run by oil or petrol engines, the necessary heat can be obtained for no additional cost from the engine exhaust and cooling air.

Where electricity is available, a plant which both warms and drives the air is more convenient, requires no attention when in use and is generally economical.

It is the volume of air that dries the corn rather than the heat. So long as there is enough heat to reduce the relative humidity of the air, as it enters the corn, to about 65%, any additional heat will not speed and may actually increase the drying time (because it will reduce the moisture content of some of the finished grain to below 12–14%).

Where the heat is derived from the exhaust and cooling water of a diesel engine no further economy is possible, but very great economies can be obtained with all-electric plants by regularly reading the wet and dry bulb temperatures at the air intake and adjusting the air temperature at the fan outlet according to Table 1.

It is essential to give the most careful thought to the planning of grain storage plants before any work is done on the site and to allow for possible extension. The first consideration must be to simplify the intake of corn, which always occurs at a busy time of the year. Corn-conveying and elevating machinery represents a high proportion of the cost of the complete store, but costs can be minimised by careful arrangement of the silos in relation to loading and unloading points.

In the case of small farms with less than 100 acres of grain it is probable that a bagging type of combine will be used, and it may be possible to avoid the need for a conveyor or elevator by making use of differences in levels in hill country, or by the use of an upper floor in existing buildings as a loading platform.

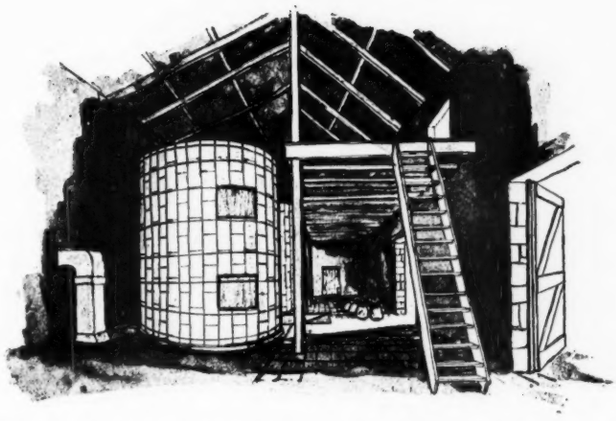
Bags of grain can be hoisted by the use of a tractor and pulleys or with a pulley attached to a frame on a tractor front-end loader, or by an ordinary hay elevator, if small bags are used, or by an electric hoist. The time taken will be greater than with an intake bin into which the corn can be tipped at ground level, but the installation cost is greatly reduced.

Plenty of floor space for corn in combine bags waiting to be cleaned is essential. Time and labour for cleaning is often available in the morning before combining can start, but there must be waiting space enough to hold this corn and still give room for working.

For larger concerns, whether bagger or tanker combines are used, an intake hopper at ground level is essential. It should be big enough to hold not less than one day's combine output. The cost of waterproofing a hopper built in wet ground is very great and it is

better to adjust the layout so as to place the intake at the highest and driest point or, alternatively, to arrange it so that the bottom is not greatly below standing water-level in the rains.

Delivery from this intake will generally be by cup or screw elevator to the precleaner, and thence by elevator and some form of trough conveyor to the top of the silos. Any change in direction of a conveyor is always a point of trouble and it is better to arrange silos in a straight line on one or both sides of a central duct.



Sketch showing a battery of Marley silos and the air intake to the drying unit and air duct, as fitted into an existing barn

Protection

The silos must be roofed and individual conical roofs in aluminium can be supplied for all sizes of silo, but a normal roof, covering both silo and the auxiliary conveyors, ducts and the hot-air plant is better. It has been found that it is generally not necessary to sheet in or protect the sides of the silo from occasional driving rain, but accumulations of rain water running from a roof or a broken gutter can cause trouble, and it is obviously desirable to give protection on the windward side in exposed sites.

If the silos are in a totally enclosed building, an air intake from outside is essential. When the intake is inside, recirculation of wet air from above the grain down into the intake will almost always occur and will impede, or prevent, all drying. This intake must be roofed over and, as fine misty rain can be drawn in, a fair roof spread should be allowed.

The amount of storage and drying capacity required will depend on the rate of harvesting. Clearly the total volume of the storage should not be less than the maximum crop likely to be harvested by combine. Generally speaking, it takes up to 14 days to dry 10 ft. of corn from 18% to 20% down to 13% to 14% moisture content. There must therefore be sufficient drying capacity not exceeding 10 ft. in height above the false floors to take the output from the combine for 15 days.

Drying silos can be filled much higher for storage, or a further 4 ft. of damp grain can, if necessary, be added to and dried on top of the first 10 ft. so long as that has completed its drying. The maximum height of storage silos is really only limited by the greater cost of a building of over 20 ft. eaves height. It is, however, often more convenient to arrange for all the silos to be ventilated so that all can be used for drying and no time be lost in transferring dry grain. The intake pit or wet bag store must be enough to hold at least one full day's combine output.

These general considerations must be adjusted in the light of the crops to be combined. If only one variety of one grain is grown, the combining season will be short, but it can be spread by the use of suitable varieties. A short one-variety season means that most or all the silos need to be equipped for drying as well as storage. A great number of varieties will spread the season so that only half the silos need be arranged for drying.

The air duct which must enter below the false floor of the bin can be built above ground level, but this will waste some 2 ft. of the height of the silo and increase the cost and difficulty of supporting the false floor. If the duct is sunk below ground, the problem of ground water must be considered. Ducts can be built of waterproof construction, but this almost certainly involves the use of asphalt tanking, will require skilled labour and special plant and is inevitably expensive. When ground water is occasionally to be expected, the practical way out is to arrange the ducts with a slight fall to one end, and to provide a 3-in. concrete pipe drain to a suitable outfall.

The floor will have to carry the weight of the false floor, part of the corn, and the far greater weight of the walls, which, in fact, carry a high proportion of the weight of the stored corn. It is therefore essential to have a really firm foundation, and any filling or hard core used to level up must be properly rammed. A 6-in. thickness of concrete will be sufficient if the ground underneath is really firm. If this cannot be arranged, reinforcement by light-

The increasing use of the combine harvester has made it necessary for the farmer to have facilities for grain drying and storage Photo: U.S.I.S.

TABLE 1
Operating Chart

Take the difference between the wet and dry bulb temperature and find this figure in the left-hand vertical column. Then take the temperature of the air entering the fan and find this in the top horizontal row. Where these two lines meet will be the best working temperature for the air leaving the fan heater; a higher temperature will require more electric current and will not speed drying.

Example: If difference between dry and wet bulbs is 3°F and the outside temperature is 64°F, the air in the duct must be at 71°F. See boxed figures in table.

Where no temperatures are given there is no advantage in using the heater.

Difference between dry and wet bulbs, °F	*Temperature of outside air* (i.e. *dry bulb*), °F																				
	80	78	76	74	72	70	68	66	[64]	62	60	58	56	54	52	50	48	46	44	42	40	38
1	92	90	88	86	83	81	79	76	74	72	71	68	66	64	62	60	58	56	53	51	48	46
2	91	89	86	84	82	80	78	75	73	71	69	67	64	62	60	58	56	53	51	49	45	44
[3]	89	87	85	83	80	78	76	73	[71]	69	66	64	62	60	58	56	54	51	48	45	43	41
4	88	85	83	81	78	76	74	72	69	67	65	62	60	58	56	53	50	48	45	43	—	—
5	86	84	81	79	77	75	73	70	68	65	63	60	58	55	53	—	—	—	—	—	—	—
6	84	82	80	77	75	73	70	68	65	63	—	—	—	—	—	—	—	—	—	—	—	—
7	83	80	78	76	73	71	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8	81	79	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

weight mesh must be placed in the middle of the concrete and must extend beyond the outside of the silo wall.

When the silo is to be used for drying and has a false floor, there is no chance of the grain getting damp by contact with the ground, but where the silo is to be used for storage only a dampcourse over the floor area is essential. The simplest way is to lay the usual 6-in. floor slab, then to tar the upper side with a really full coat of coal tar and to finish off with a 2-in. layer of fine concrete or cement and sand. If the tar is warmed and thickened with a proportion of pitch, it will be easier to lay the finishing concrete.

Operation

It is essential to put the corn through a pre-cleaner after it comes from the combine to take out green stuff, thistle heads, and so on. This greatly speeds drying and prevents mildew forming.

Corn may be filled to any depth up to a maximum of 10 ft. The rate of drying with a greater depth is much reduced and mildewing of the upper layers can occur. If the corn is very wet (over 20% moisture content), it is better and in the end quicker to fill only to 4 or 5 ft. deep, and when this is finished to do another lot. If the depth is greater, the rate of drying is reduced and mildew may develop in the upper layer of corn.

When filling, the corn will form a conical mound below the intake spout. Because of the way the grain lies, particularly oats, the air is deflected and a damp pocket could result. Therefore, pull this cone over two or three times in the course of filling the silo and level the corn each time and again when the filling is finished.

It is essential to have a moisture testing outfit. The grain, after it has been through the pre-cleaner, should be tested and the depth of load determined. Up to 20% moisture content, any depth not exceeding 10 ft.; from 20% to 24%, not more than, say, 5 ft.; over 24%, very shallow loads up to 2 ft. or 3 ft. are best, but there will be difficulty.

Blowing may start as soon as the false floor is well covered and it will be found that samples drawn from the bottom will fall to 12% to 14% in the first 24 hours, but samples drawn from just below the surface will increase to a steady figure of about 20%. The mass continues to dry upwards and should be left in until the test from about 6 in. below the surface lies between 12% and 14%. The state of drying can be judged by the 'feel' of the top layer of corn, but it can be misleading and reliance should never be placed on this simple method of testing alone.

A grain thermometer – range 32°F to 180°F, made like a clinical thermometer, so that it will not fall unless shaken down – should be available at every bulk storage installation. This can be used to take the temperature of the grain at any depth by means of a grain spear (a ½-in. diameter tube with a pointed end) which can be pushed into the grain from above. The temperature of well-dried grain will remain practically steady throughout the year; a temperature rise will indicate either dampness, or the action of grain weevils.

All silos and ducts and the conveyor system should be very carefully brushed out each year to prevent a build-up of weevils, mites and eggs. Regular cleaning down and the removal of dust is normally enough to ensure freedom from trouble and is better than letting things get so bad as to necessitate chemical spraying.

Sketch on page 97: Marley Concrete Ltd.

Fighting The Cocoa Capsid in Ghana—I

Organisation of a National Spraying Campaign

N. WRIGHT, B.SC., A.R.C.S., A.I.C.T.A.
(*Fernhurst Research Station*)

This first part describes the conditions under which cocoa is grown in Ghana and the severe damage done to the crop by the capsid bug; it also gives an account of the experimental work on which the present campaign for the eradication of this destructive pest is based.

NO visitor to Ghana can travel far without realising the dominant part played by cocoa not only in the agricultural industry, but in the total economy of the country. He does not need to be specially qualified or observant to note also that much of the cocoa looks sickly. Most of that degeneration in the condition of the trees is due to two species of capsid bug, *Sahlbergella singularis* (Hagl.) and *Distantiella theobroma* (Dist.), particularly the former.

In June last year Mr. F. Y. Asare, Minister of Agriculture in Ghana, announced his Government's proposal to spend rather more than £12 million in carrying out an ambitious and well-planned scheme to spray annually 2¼ million acres of cocoa over the next five years to bring this pest under control. Such a scheme would not have been possible but for carefully-thought-out experimental work, followed by spraying campaigns on a gradually increasing scale to gain the necessary experience in the technique and economics of the operation.

Severe losses

The 1953 Cocoa Conference,[1] held in London under the auspices of the Cocoa, Chocolate and Confectionery Alliance, drew public attention to the heavy losses of cocoa sustained by the industry as a result of capsid damage and stressed that they were little less serious than those caused by swollen shoot disease. Production losses in Ghana were then unofficially estimated at 60,000–80,000 tons a year, equivalent to one full year's production every four years.

Following this conference, the Ghana Department of Agriculture prepared their plans for an experimental programme designed to discover the best insecticide and the best method of applying it in the large-scale treatment of mature cocoa. This required practical experience both in the chemical and spray application fields; the Department therefore accepted the offer of help made by Plant Protection Ltd. (a subsidiary of Imperial Chemical Industries Ltd.) and from the outset the technical services of this company have been employed.

Spraying problem

Cocoa in Ghana is farmed by African smallholders, each possessing only a few acres of cocoa trees interspersed with food crops. Most of the trees are densely planted, spacing is irregular and shade trees too numerous; as a result growth is tall and spindly. These cocoa 'thickets', growing up to 25 ft. or more in height, have not been well cared for and weeds have been allowed to compete freely with the cocoa. With the added hazards of the rough and irregular terrain the spraying problem presented was one of considerable difficulty. The use of tractor-drawn or mounted equipment was clearly out of the question.

The organisation of the experimental work was, however, simplified by the existence of detailed records and surveys of all cocoa areas in Ghana; these are prepared and kept constantly up to date by the Department of Agriculture in connection with swollen shoot control, but the extent and severity of capsid damage were also obtainable from them. Furthermore, considerable resources of personnel were immediately available within the Department, who, though untrained in spraying techniques, were familiar with cocoa as a crop and possessed detailed knowledge of the districts to which they were attached. Out of the total cocoa area of slightly over 4 million acres, it was known that more than half the acreage was severely capsid-infested and showed varying degrees of die-back.

Photo: G. A. R. Wood, Cadbury Bros. Ltd.
Healthy high-yielding cocoa trees in Ghana

Pest damage

The primary damage done by capsids is to the tree canopy, new growth flushes suffering in particular. Capsids are sucking insects; though their numbers are not large, a single insect puncture in a new extension shoot can cause the death of that shoot because the capsid's saliva is toxic and die-back occurs, often accompanied by disease. Such shoots present a characteristic appearance, with dead leaves, brown in colour, hanging vertically downwards. These eventually fall and the branches

A poor overhead canopy. The primary damage done by capsids is to the new shoots and to the branches which are reduced to bare sticks. The overall loss in crop is more than 25%, which is equivalent to 50,000 tons per annum, worth £15 million

become reduced to bare ' poles '. The canopy is thus destroyed.

Capsids also feed on cocoa pods, especially the nymphs, causing dark brown sunken areas. The damage done to pods is unimportant, but after harvest the capsids move up into the canopy; this explains why the most severe capsid injury occurs in West Africa during the period November to February.

Experimental work

In 1954, when the Ghana experiments were being planned, it was known that both DDT and BHC were effective agents against capsid bugs of cocoa. The West African Cocoa Research Institute (W.A.C.R.I.) had worked out a technique of applying DDT to young cocoa trees by brushing or painting the solution on the branch unions.[2] In the cocoa plantations of the Belgian Congo they were using BHC dusts with rotary hand dusters.[3] Neither of these methods was suitable for large-scale use on mature trees, so that the first and most difficult problem to solve was one of application. The portable, engine-driven mistblower eventually gave the answer and undoubtedly proved the turning point in the development of a spraying technique for the forest-grown cocoa of West Africa.

No formal or statistical trial layout is possible in a peasant crop such as cocoa in Ghana; the lack of uniformity makes selection of sites a difficult matter and the use of a conventional ' control ' plot virtually impossible. Treatments had to be applied to single trial sites – usually a complete farm – and replication was achieved by having numerous single-treatment sites scattered over a wide area of country. Assessment of results was based on a numerical estimate of the condition of the canopy in 50–100 sample trees per site and on records of pod damage and pod yields – all recorded monthly.

In 1954, the first year of experiments, 26 trial sites were established and after a season's observations proved conclusively that gamma-BHC treatments were not only superior to DDT sprays, but prevented capsid damage at all sites. The appearance of trees in gamma-BHC plots was completely changed; even trees which had been reduced to bare branches were now making vigorous growth and forming new canopies. Control areas adjacent to them were also largely free from capsid damage, suggesting a repellent or even toxic action by the gamma-BHC well outside the sprayed zone.

The ' standard treatment '

More detailed information was required on gamma-BHC dosage and frequency of spraying. The number of sites in 1955 was thus extended to 57, and by early 1956, when results had been studied, it became possible to establish a ' standard treatment '. This was stated as ' two applications of 4 oz. gamma-BHC per acre applied by mistblower at an interval of four weeks between sprays; control is maintained by regular inspection and retreatment of localised areas wherever damage occurs '.

The experiments have also proved the efficacy of sprays based on a gamma-BHC miscible liquid; the product, ' Gammalin ' 20, forms a stable emulsion when diluted with water for spraying. The amount of wash applied was standardised at 5 gal. per acre.

Table 1
Summary of yield increases over three years
(based on main crop yields only)

Average yield per acre of units during the first season of spraying (grouped into classes)	*Number of plots*	*Percentage increase in average yield per acre over 1954*	
		Second year of treatment	*Third year of treatment*
Under 100 lb.	2	244	623
100–200 lb.	8	112	244
200–300 lb.	4	78	156
300–400 lb.	2	19	68
400–600 lb.	2	15	120
Over 600 lb.	1	4	43

A good overhead canopy – hence a poor photograph. This area has been subjected to the ' Standard Treatment ', in which two applications of a gamma-BHC miscible liquid – the formulation ' Gammalin 20 ' – diluted with water are applied by mistblower at an interval of four weeks

The experimental units were increased still further in 1956 and comprised over 100 sites on about 1,500 acres. The new series of trials were used to examine retreatment techniques, including the use of hand equipment and also lower dosage rates. At about this stage also other synthetic insecticides were included in the comparisons, but none was found so suitable as ' Gammalin ' 20 for combining high toxicity to capsids, freedom from injurious effects on the tree and to the manufactured cocoa or chocolate and complete safety to operators.

The results

The ultimate criterion of success in any spraying operation must be the added revenue to the farmer. The yield increases recorded by the Department of Agriculture in Ghana as a result of capsid spraying with gamma-BHC have been astonishing; Table 1, given by Hammond,[4] illustrates this point.

Suffice it to add that records from much larger units than the above have amply confirmed these experimental data. For the latest scheme, just starting, the Ghana Government have taken a conservative estimate of 25% increase in output, but even at this figure the extra crop from the $2\frac{1}{4}$ million acres to be sprayed would be 50,000 tons, representing an increased revenue (at a cocoa price of £300 per ton) of £15 million.

REFERENCES

1. The Cocoa, Chocolate and Confectionery Alliance: ' Cocoa Conference, 1953 '.
2. Taylor, D. J.: ' A Summary of the Results of Capsid Research in the Gold Coast ', *West African Cocoa Research Institute Tech. Bull.*, 1954, No. 1.
3. Bellefroid, M. V. de: ' The Problems of Regeneration after Severe Capsid Damage ', *The Cocoa, Chocolate and Confectionery Alliance: Cocoa Conference*, 1953.
4. Hammond, P. S.: ' Capsid Control on Mature Cocoa ', *New Gold Coast Farmer*, 1957, Vol. 1, No. 7.

(*To be continued*)

Recommended Cereals, 1959

Two new varieties of wheat and one winter oat are added to the N.I.A.B. recommended lists for 1959 as promising new varieties. These are the spring wheat Jufy I, a very heavy-yielding variety with short stiff straw, but grain of low milling quality, and the winter wheat Flamingo, which is also very heavy yielding, with stiff but fairly long straw; its grain is suitable for biscuit making, but, like all white grain varieties, is rather liable to sprout in a wet harvest. The Welsh Plant Breeding Station variety of winter oat, Penrhyn, is now recommended as very heavy yielding; it has straw in the S.147 class and is late maturing: seed supplies are likely to be limited in 1959.

There are several minor changes in the lists. The early spring wheat Svenno is promoted to a ' General ' (G) recommendation, and Atle, which has now been outyielded by many newer varieties, is given a ' Special ' (S) recommendation for conditions in which high resistance to sprouting and high grain quality are required. The winter wheat Banco, with heavy yields, late maturity and good grain quality, is promoted to a ' General ' recommendation. N.59 is recommended for special use in the North. The spring barley Provost is transferred from the category of ' New ' (N) to ' Special ' recommendation as a late malting quality variety. The winter oat Powys is now given a ' General ' recommendation for its short stiff straw and good yields.

Several varieties are now described as becoming outclassed (O) and therefore likely to be withdrawn from the recommended lists in two years' time. They are: Squarehead's Master winter wheat, Fylgia II spring wheat, Spratt-Archer, Plumage-Archer and Carlsberg II spring barleys and Picton winter oats.

The full recommended lists for 1959 are as follows:

Spring wheats: Jufy I (N), Koga II (N), Svenno (G), Atson (G), Peko (N), Atle (S), Fylgia II (O).

Winter wheats: Cappelle Desprez (G), Flamingo (N), Minister (G), Hybrid 46 (G), Banco (G), N.59 (S), Dominator (N), Milfast (N), Bersee (O), Squarehead's Master (O).

Spring barleys: Rika (G), Herta (O), Proctor (G), Carlsberg II (O), Freja (S), Provost (S), Maythorpe (S), Spratt-Archer (O), Earl (S), Plumage-Archer (O).

Winter barley: Pioneer (G).

Spring oats: Blenda (G), Sun II (G), Opus II (O), Maldwyn (G), Milford (S).

Winter oats: Penrhyn (N), Powys (G), S.147 (G), Picton (O), S.172 (G).

Wheat Grain Slicer

Remarkable Invention from Hungary

Two Canadian experts recently visited Hungary to investigate the claims made for a very remarkable machine – a wheat grain slicer – which was shown last year at the Brussels Fair. They were Mr. J. A. Anderson, head of the Wheat Research Laboratory, and Mr. J. B. Laurie, head of the European Department of the Ministry of Agriculture of Canada.

They first of all inspected the installation at the Obuda mill, where there is a machine which slices millions of grains of wheat every hour, separates the parts and thus produces flour of different baking qualities. It can also separate the buds or germinating points, which will produce wheat plants just as good as those grown from the whole grain.

The report states that the visitors were unable to see any difference in plant size between two areas which had been sown, one with the cut wheat and the other with the whole wheat; they had actually to lift several plants to decide which was which. It would appear that the use of this machine could revolutionise the milling industry.

NOTE FOR CONTRIBUTORS AND AUTHORS

The editor welcomes authoritative articles and news items on agricultural machinery and agricultural methods, agricultural crops and new developments.

The purpose of WORLD CROPS is to keep horticulturists, farmers, plantation managers and specialists in related fields of research informed of the latest developments in agriculture.

Articles should therefore be written in the kind of language which the layman can understand, particularly since an expert in one field is a layman in another.

A short synopsis should preferably be included to assist the editor and the manuscript itself should be typed in double spacing with plenty of margin and on one side of paper only.

It should bear the name and address of the author and be accompanied by sharp photographs or line drawings with suitable captions.

An aerial view over a part of the pineapple fields, showing how the crop is tailored to fit the machine and the fields are arranged to follow the contours. The marginal strip around the jungle area is heavily treated with insecticides to provide a protecting barrier

The Pineapple —

Crowned King of Fruits

A new series of technical books is shortly to be published under the general editorship of Prof. N. Polunin, of Bagdad University. These will cover all the economically important world crops, and will take the form of a survey, produced by an acknowledged authority, of the botany, cultivation and utilisation of each crop.

THE first in the series of World Crop Books is to be 'The Pineapple', by Dr. J. L. Collins, an American, who has had a distinguished career in the field of plant genetics. Dr. Collins was, for many years, geneticist to the Experimental Station of the Hawaiian Pineapple Canners' Association, and subsequently geneticist and acting director of the Pineapple Research Institute of Hawaii. He is recognised as a leading authority on this crop.

The fruit

The pineapple is today one of the most important fruit crops, yet it was unknown to Europeans before its discovery by Columbus in 1493. However, in the 200 years following its discovery the pineapple was distributed throughout the tropics and was successfully carried to Europe as a table fruit. Later, as a hothouse plant, it was the object of interest to keen gardeners, both in England and on the Continent. Many new cultural procedures and varietal characters were developed before this interest waned.

The common name, pineapple, is limited to the genera *Ananas* and *Pseudananas*, which belong to the family Bromeliaceae. This family has two distinct habitat groups, the terrestial and the epiphytes. The pineapple we eat belongs to the terrestial division of the family, but has some of the characters of the epiphytes, in particular the ability to endure long periods of drought.

Most of the members of the Bromeliaceae are found under natural conditions in the tropical and subtropical regions of the Americas, though a few species are also to be found in the temperate zones. A study of the present geographical distribution of wild species of pineapple suggests that the probable area of origin is somewhere in the region of central and southern Brazil, northern Argentina and Paraguay.

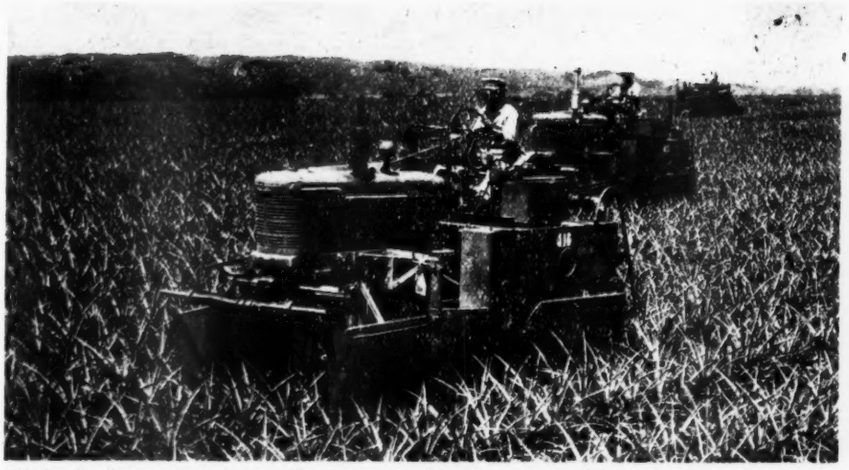
The smooth Cayenne

The more important varieties, from the standpoint of commercial development, are relatively few, and of these the spineless-leaved or smooth Cayenne is outstanding. Of the 10 major producing areas of the world, only four are using varieties other than, or in addition to, the smooth Cayenne and the trend would seem to be towards increased use of this variety as rapidly as planting material becomes available.

The plant presents some definite disadvantages as well as some desirable features as a medium for morphological investigations and for breeding work,

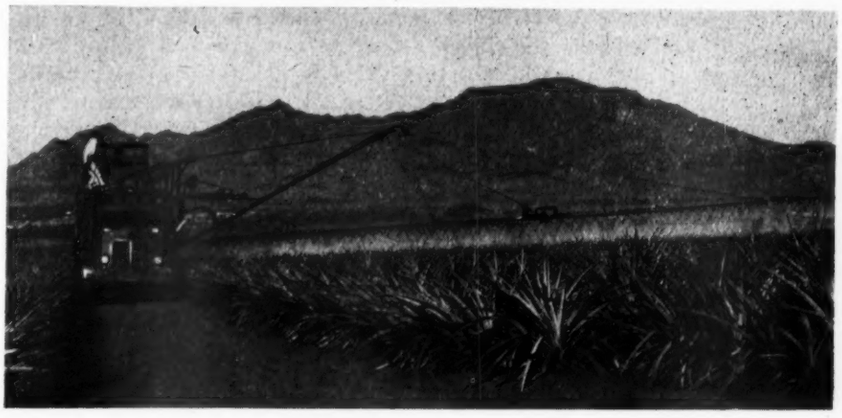
which requires several sexual generations for completion. Even the period of two years needed for asexual generation seems a long time to wait for results from such experiments. In breeding, sexual generation requires twice as long as asexual generation. The culturing of many thousands of hybrid seedlings and the maintenance of living stocks of species and varieties is expensive, requires much equipment and occupies a considerable land area. Because of these requirements much of the genetic information has been obtained as a by-product of commercial breeding and agricultural operations.

In a population of plants resulting from the vegetative propagation of a single individual there is also much variation in the degree of expression of morphological and physiological characters. This is the result of differences in environment acting upon individuals during growth. The factors of the environment can only alter the growth and growth tempo or degree of expression, but cannot produce, or call into being, characters not already determined by the genotype. Certain environmental factors have an important modifying influence on the development of genetic characters and these are described in some detail.



High-wheeled tractors are used to spray herbicides and to cultivate between the plants in one operation. Divertors gently brush aside the leaves. Fertilisers are applied in the same way

A 30-ft. boom sprayer used for applying insecticides and liquid fertilisers and weed-killers for early weed control



Soil and climate

The pineapple is a perennial which does not have a natural period of dormancy and will continue to grow as long as the environmental conditions are adequate. Temperature is the critical climatic factor in the growth of the fruit, which cannot tolerate frost. Production is therefore confined to frost-free regions and even in the tropics is restricted to the relatively lower altitudes. Rainfall is not such an important influence on the geographical distribution of the fruit, as it shows a natural ability to adjust itself to differences in the amount of precipitation and there is a considerable variation in rainfall between the major growing areas.

A paper-laying combine. This machine simultaneously injects fumigant into the soil, lays three continuous bands of paper mulch and anchors them with soil. The white marks are to guide the planting

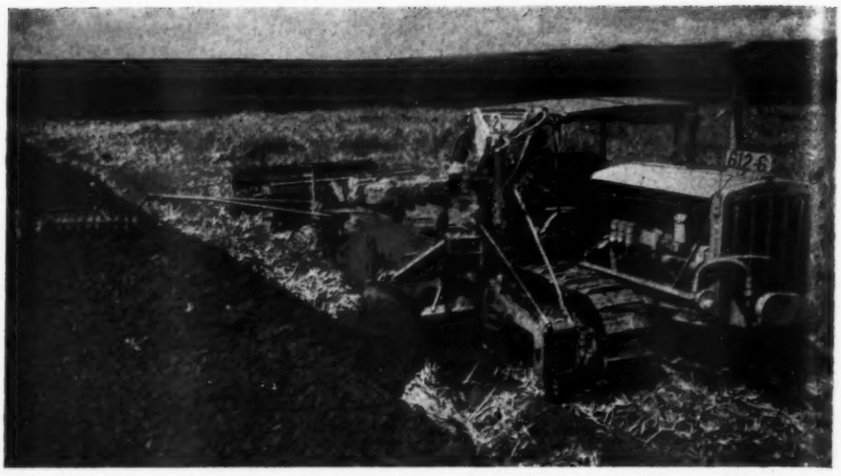
Just as there is one critical climatic factor which limits the growing of pineapples to certain regions, there is also one overall soil requirement which restricts the production of the fruit to definite areas. Pineapples can be grown successfully only in well-drained and aerated soils. The red or reddish-brown lateritic, volcanic and the peat soils common in the tropics are well suited to the pineapple. The lateritic soils, largely derived from the erosion of igneous rocks, usually contain considerable quantities of iron oxides, an essential nutrient requirement. If this element is lacking, a rain of ferrous sulphate has to be applied to prevent chlorosis.

Commercial growing was begun in Hawaii, Singapore and Malaya almost simultaneously about 50 years ago. The 10 principal production areas, which lie in a belt around the globe, extending between latitudes 30° north and south are, in approximate ranking in their contributions to the world trade in canned pineapple – Hawaii, Philippines, Malaya, Australia, South Africa, Puerto Rico, Kenya, Mexico, Cuba and Formosa. Of these, Hawaii is undoubtedly the most important producing country.

The industry was started in Hawaii over half a century ago in a number of smallholdings; today this is among the most highly mechanised and industrialised farming and processing industries in the world and it produces about 70% of the total supply of canned pineapple. The operations in the field are totally mechanised, except for planting.

Although the land under pineapple in the Hawaiian islands is less than a quarter of the total cultivated land area, this is intensively farmed by 10 pineapple companies, who operate 14 plantations and own nine canneries. With the exception of two companies, all the pineapples are produced under a central management which co-ordinates all stages in production, processing and marketing. Supported by a high degree of mechanisation, both in field and factory operations, this has been found to provide the most efficient and economical means of operation, in spite of the very high wages paid in that country.

Several of the other producing areas suffered considerable damage during the Second World War, notably the Philippines, Formosa and Malaya. This gave these areas the dubious advantage of having to restart virtually from scratch and has made possible a complete reorganisation of the industry in each case.



Smashing down and cutting up the plants in an old field, then ploughing and harrowing all in one operation

This is particularly true of Malaya, where the industry was almost entirely wiped out. The fields disappeared and the canneries were destroyed. This provided an opportunity to plan and build a co-ordinated industry, starting with the basic requirements of the producing fields to the mechanisation of the canneries and the organisation of marketing through a board. In accepting this opportunity, Malaya abandoned the former upland lateritic areas for pineapple growing and opened up huge areas of peat in the lowlands, where entirely new cultural techniques are required.

Pests and diseases

Like most plant species which have occupied an extensive area for a long time, the pineapple is susceptible to a number of diseases, abnormalities and pests. These vary widely in their influence upon the host plant.

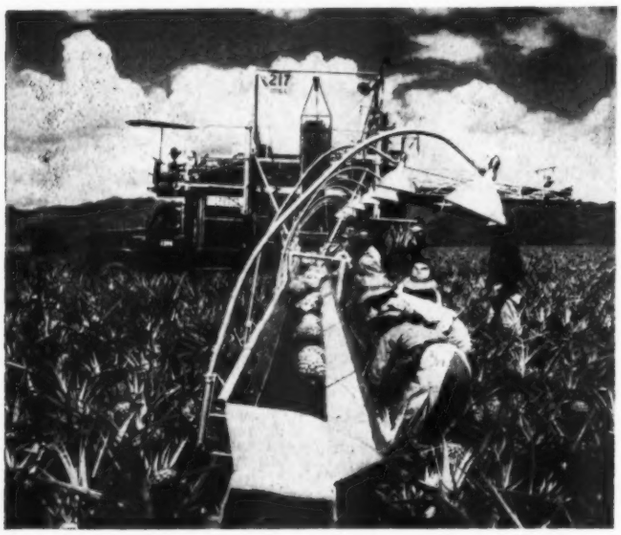
Mealy bug wilt is the most widely distributed pineapple disease and one of the most damaging, particularly to plants of the Cayenne variety. There are also about 20 other diseases which may attack the pineapple, together with a number of pests, including borers and termites. The author describes the causes and effects of these plant afflictions and recommends effective treatment.

Pineapple products

The fruit is marketed in six forms: slices, chunks, crushed, or juice in tins, as preserved fruit and as the deep-frozen product, and there are also by-products, such as citric acid, cattle food and fibre.

In the most modern and up-to-date factories the fruit is not touched by hand and yet from the time it is mechanically harvested in the field to the time when the product is consumed the following operations have been carried out: grading the fruits, topping, tailing, coring, washing, slicing, grading, canning, syruping, exhausting, cooking, cooling and finally packing into fibreboard containers. And so it goes out to the four corners of the globe.

Dr. Collins concludes his most useful textbook with a most comprehensive list of references. Summing up, this book will effectively bridge the gap between the highly specialised monograph and the over-simplified popular farming manual.



The mechanical harvesting of pineapples in Hawaii. This is a boom conveyor, fed by a team of men who follow the forward progress of the boom, cutting the fruits as they advance. The lights are for night operations during the peak period

Photos : Hawaiian Pineapple Co.

Weeds in Temperate Regions—2

The Control of Weeds in Cereals

On the opening day of the Fourth British Weed Control Conference, the important subject of the control of weeds in the main cereal crops – wheat, oats and barley – was discussed under the sessional chairmanship of Mr. R. B. Ferro. Five research papers were given, after which the discussion was opened by Mr. C. V. Dadd. These papers considered the effects of the applications of various weed-killers at various strengths on various cereal crops at various stages of growth, and the effectiveness of various weed-killers on that most persistent weed, *Galium aparine* or cleavers.

A most important conclusion that has been reached, is that any new herbicide should be tested on a wide range of varieties before it is placed on the market, as there are varietal differences in susceptibility to damage. Another is the value of mixed weed-killers to deal with both the non-resistant and the hormone-resistant weeds, found in cereal crops.

The following is a very brief summary of the five papers, presented during the third session of the Conference:

WEED CONTROL IN CEREALS

Selective Weed Control with CMPP and Sodium Monochloroacetate *by A. F. J. Wheeler* (*Plant Protection Ltd.*)

A series of trials was laid down to evaluate alpha (4-chloro-2-methyl phenoxy) propionic acid (CMPP) in comparison with sodium monochloroacetate as selective herbicides in cereals, particularly crops infested with *Galium aparine* (cleavers) and *Stellaria media* (chickweed).

2.5 lb./acre CMPP was very effective against *Galium aparine*, 2 lb./acre was unsatisfactory for control of over-wintered infestations in winter cereals. *Stellaria media* was eradicated with 2 lb./acre CMPP.

Sodium monochloroacetate was generally disappointing against these weeds. The standard dosage rate of 20 lb./acre reduced *Galium aparine* by 59% and *Stellaria media* by 63% on an overall average. *Polygonum persicaria* (redshank) and *Polygonum convolvulus* (black bindweed) are very susceptible to sodium monochloroacetate.

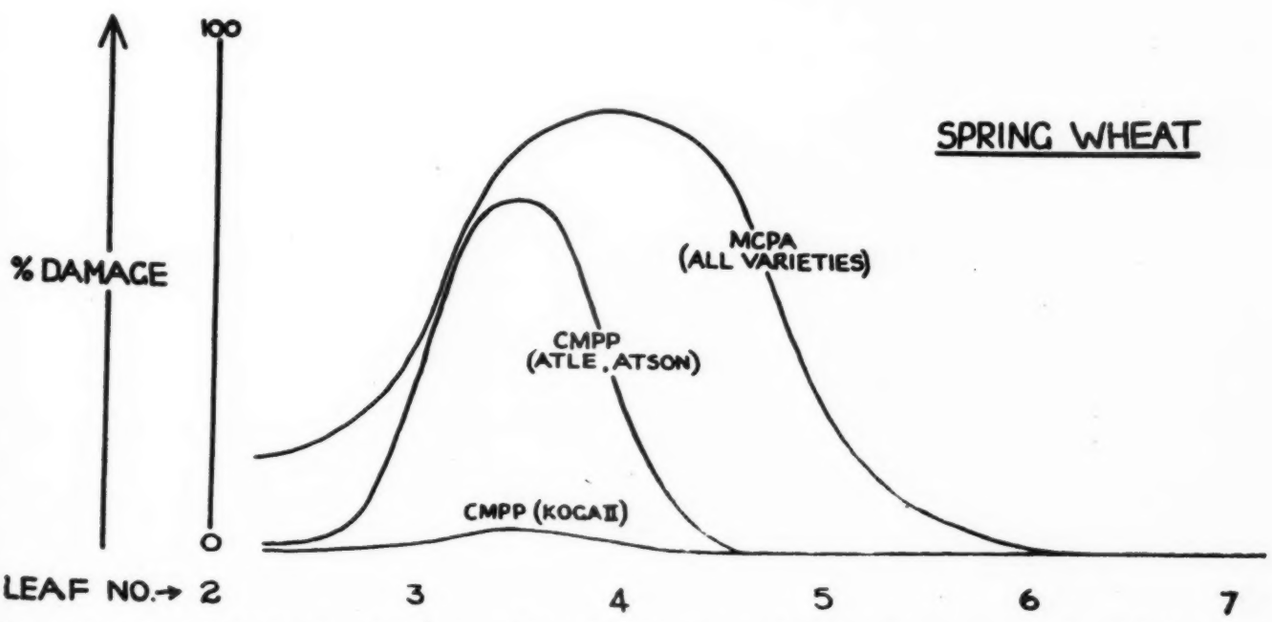
Both CMPP and sodium monochloroacetate caused a negligible incidence of malformity to spring wheat, oats and barley sprayed early, and neither material caused significant reductions in yields of these crops.

Further Work with CMPP in Cereal Crops *by G. B. Lush, E. L. Leafe and A. J. Mayes* (*Boots Pure Drug Co. Ltd.*)

At the Third British Weed Control Conference in 1956, Leafe and Lush first announced the activity of CMPP against cleavers. In their papers they described how CMPP at 2–2½ lb. per acre effectively controlled cleavers, chickweed and a range of other weeds with a wide margin of safety in cereal crops.

Further work has shown that differential rates of application for cleavers, chickweed and a number of other weeds are indicated, and the various weeds are listed in groups according to their susceptibility to CMPP. Some effects of climatic conditions on the response of weeds to CMPP are also discussed.

The position of CMPP with regard to cereal tolerance is considered.



An idealised diagram showing the relative susceptibility of various spring wheat varieties at a series of growth stages to treatment with CMPP and MCPA at normal rates (*Paper by Lush, Leafe and Mayes*)

Special emphasis is given to the question of early spraying, and varietal susceptibility during the early phases of growth.

The Use of 2,3,6-TBA MCPA Mixtures for Selective Weed Control in Cereals *by R. K. Pfeiffer (Fisons Pest Control Ltd.)*

In an attempt to find an answer to the increasing problem of weeds in cereals resistant to MCPA and 2,4-D, a specific activity of 2,3,6-TBA and some closely related compounds on many 'hormone-resistant' species was discovered at Chesterford Park. Further work led to the development of a new weedkiller, Fisons 18-15, based on a mixture of polychlorbenzoic acids (predominantly 2,3,6-TBA) with MCPA. All cereal crops with the exception of spring wheat have proved unaffected if sprayed between tillering and the beginning of the jointing stage. The safe period on spring wheat appears to be shorter.

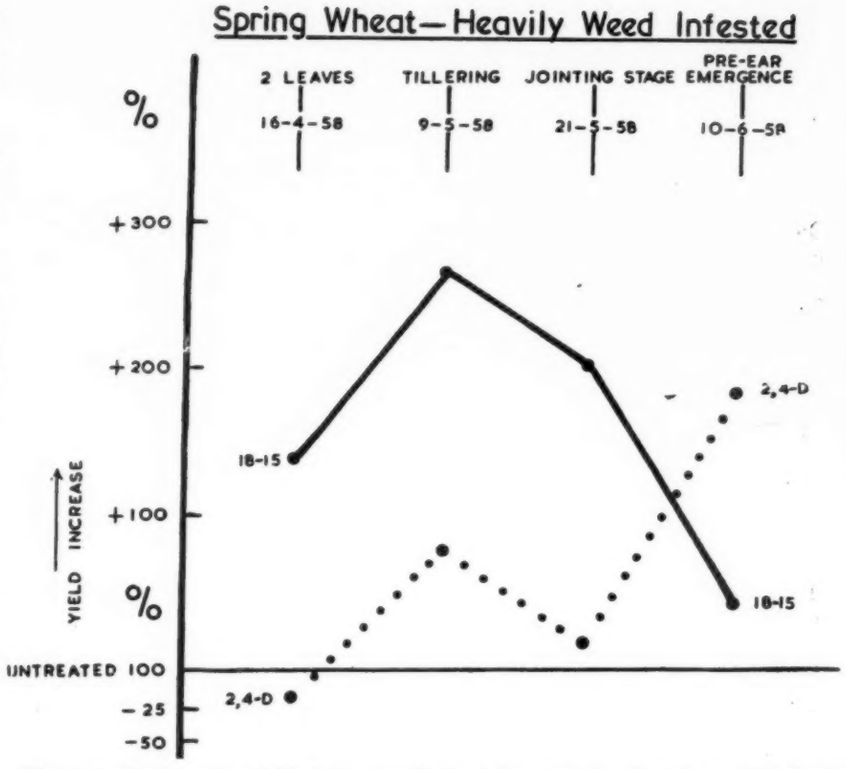


Diagram showing the yield increases obtained by spraying heavily weed-infested spring wheat at various stages of growth with 18-15 and 2,4-D at normal rates

The Relative Susceptibility of Cereal Varieties to Growth Regulator Herbicides *by C. S. Elliott (National Institute of Agricultural Botany)*

With the great increase in use during recent years of the growth regulator herbicides there have been reports by farmers and others of varietal differences in susceptibility to spray damage.

Experiments have confirmed that varieties of spring wheats, oats and barleys do differ in their reaction to the growth regulator herbicides. In some instances the differences appear to be quite large, which emphasises the importance of testing any new herbicide on a wide range of varieties before it is placed on the market.

In these experiments heavy doses were used and in many cases the chemicals were not applied at the commercially recommended growth stage. It is assumed that the varietal differences in response, which were demonstrated, would have been far smaller if the manufacturer's recommendations had been followed.

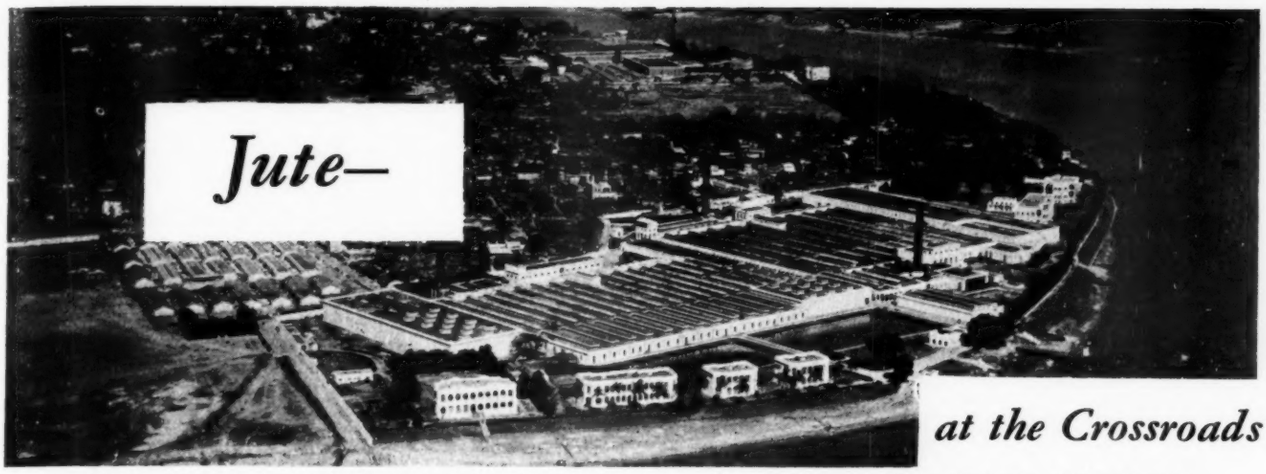
Varietal differences in susceptibility to damage from 2,4-D, as seen two months after spraying: Photo: N.I.A.B.

J. 'Sun II' slight damage — *K. 'Maldwyn' moderately severe damage* — *L. 'Flamande Desprez' severe damage*

Control of Galium with MCPP *by J. Lhoste, A. Casanova and P. Stouff (Labatoire des Pesticides, Procida)*

Some experiments with CMPP, alpha (4-chloro-2-methyl phenoxy) propionic acid, which is known to have a selective phytotoxicity on *Galium aparine* are described.

It was found possible to obtain complete control of *Galium aparine* either by treating with DNOC – NH_4 or with CMPP–K. With the former a dose rate of 2.4 kg./ha. was sufficient, provided that the treatment is taking place up to the two-leaf stage. With CMPP it is possible to treat later. This year (1958), the right time for treating was from April 15 to May 10, a period of more than three weeks, and the correct dosage rate was 2.7 kg./ha. in 200, 400 or 1,000 litres of water per ha.



Jute— at the Crossroads

Calcutta is the centre of the jute industry. The picture shows a few of the jute mills on the banks of the Hooghli

A. E. HAARER, F.L.S., and C. R. HARLER, PH.D.

Jute is the bast fibre obtained from the stems of lowland jute, Corchorus capsularis, *and upland jute,* Corchorus olitorius. *Both species are cultivated in a number of countries, but the highest production is in India and Pakistan. Today the industry is facing increasing competition and needs to consider its position.*

TWO considerations have been worrying jute interests in Pakistan and India for some time. Firstly, there is the constant effort in all parts of the world to avoid importing jute on account of its high price; and, secondly, there is the growing competition from substitutes and the bulk handling of commodities.

No one can ignore the revolution and change-over to multi-wall paper bags in the cement and fertiliser trade, or the ever-growing bulk handling of raw sugar, copra and similar commodities.

Even when jute was much cheaper in price several countries were examining the possibilities of growing the crop. There are small areas in Brazil, Taiwan (Formosa), Burma, Nepal, Iran and Japan, but in 1954 the total production of all these countries only amounted to 62,000 metric tons, as against a total of over $1\frac{3}{4}$ million tons from India and Pakistan. In general, owing to the low cost and the abundant labour in India, it has not hitherto been economic for these countries to compete, except by organising the industry in larger and closely adjacent fields, and by mechanising the harvesting, handling and processing of the canes.

Competition from other fibres

The soft fibres which compete with jute are cotton, flax, hemp, kenaf, ramie and sunn; the man-made fibres – nylon, orlon, polyethylene, terylene and viscose and, of course, the forest product, paper pulp. Jute is a lignocellulose, standing midway between cotton, which is almost pure cellulose, and the lignose of wood. Good quality jute contains up to 70% cellulose and 25% lignins.

India is particularly perturbed about the increasing cultivation of kenaf, *Hibiscus cannabinus*, in preference to the true jute, *Corchorus olitorius*, or *C. capsularis*, in her own States. There is always a climatic threat to the winning of a good or normal crop of jute. Jute requires ample moisture in the soil during seed sowing and growth. Too much rain is harmful and, although the crop will bear flooding when growth is advanced, the flooding can be harmful if it is prolonged or too deep. The lack of sufficient rain is always another possibility, the damage becoming disastrous if a drought is prolonged. Jute is therefore a tender and somewhat uncertain crop, unless the exact seasonal requirements are met.

Kenaf, on the other hand, will grow well on many kinds of soil, with a seasonal rainfall of only 30 in., provided it is spread over three or four months, and if India can mix at least 40% of kenaf with jute in many of her manufactured goods, then so can other countries.

South Africa has learned from experience; at the start of the kenaf jute-substitute industry the wrong seed was sown, and the attempt to harvest, transport and ret whole stalk brought the industry in Natal to a temporary economic standstill. Nowadays a decorticating machine strips the fibrous bark in ribbons from dried stalk; the mills accept these ribbons without further preparation; and a rising production of the stronger *Phorium* fibre is assisting in the policy of doing without imported jute.

Rhodesia is going to use the same machine and a beginning has been made with 6,000 acres of kenaf. Plans are in hand for a widespread production, with the staggering of harvest by using seed strains having different times of maturity. Kenya, too, is planning to use kenaf along with sisal tow on a much larger scale; in Tanganyika continued trials with kenaf and jute are being made: all of these are indicative of the wish to reduce imports of jute.

Belgian and French territories to the west of Africa are increasing their use of home-grown Congo jute, *Urena lobata*, and they are testing out kenaf. Israel is growing kenaf, and so are the Philippines, while Australia is using some of her trust territories for the same purpose.

It is reported that kenaf is weaker than jute by the Belfast mills who are trying out kenaf from Spain; but

A field of jute ready for cutting. The fibre is obtained from two species of Corchorus, *a plant indigenous to Bengal, where it has been cultivated from very remote times*

one by one the different countries are gaining experience in how to strengthen the fibre by the direct decortication of maturer stalk.

An obsolete industry

The jute-growing industry of Pakistan and India is crippled by fragmentation. The plots grown by the many peasant farmers are often very small and they are not even adjacent in many cases. The industry needs a thorough reorganisation if its future is to be made secure.

For years, since the inception of the industry, the peasant grower has had no more from his jute than a bare and miserable subsistence. The middlemen, the buyers, and merchants who handle the product have made money, and circumstances have not changed much today despite the good price of raw jute and of jute goods.

Everyone who mentions the word fragmentation and the possibility of reorganisation is cried down with the word ' impossible '.

Nothing is impossible! Not until the growers are organised into association can levies and controlled marketing improve their lot, and not until communal planting makes larger stands can seeding, harvesting and extraction be mechanised. Not until modern methods are introduced can prices be reduced and the grower get more for his product at the same time, thus creating stability at home and a greater security in the export trade.

Most of the talk, most of what one reads about the jute trade of Pakistan and India is about modernisation in the mills, and in the marketing of manufactured goods. Seldom is there anything said about ways and means to modernise the growing of jute and the production of the raw material. This is a great pity because jute is a better fibre than kenaf and the substitution of kenaf for jute in other countries can only mean a downgrading in quality and standards.

If jute is too highly priced for too long the increased production of substitutes will be inevitable. Jute is some five or six times higher in price today than it was in pre-war days, and when millions of pounds are being spent on the modernisation of manufacturing plants to cheapen production it is high time that means were taken to cheapen the growing and marketing of the raw product.

The jute industry

The jute industry also faces serious political problems following on the separation in 1947 of India and Pakistan. Pakistan still grows three-quarters of the world's jute, but the mills, 106 in number, are mostly in India. More mills are now being set up in Pakistan. The essential fact which both countries have to face, however, is that 85% of the market, whether for raw or manufactured fibre, lies outside India and Pakistan.

In Bengal, using this comprehensive term in the old sense to include the whole delta and what comprises today mainly East Pakistan and the Indian province of West Bengal, the rice- and jute-growing areas are in the ratio of about 8 to 1. The current relative price of the two crops is the determining factor to the current ratio. The jute area has ranged from less than two to over five million acres during the present century, with an average of $2\frac{3}{4}$ million acres. The total out-turn has varied equally widely, with an average of $1\frac{1}{2}$ million metric tons per annum. The average yield is about $1\frac{1}{4}$ tons fibre per acre.

Harvesting and processing

August and September is harvest time for jute in the deltas of the Ganges and the Brahmaputra and on every piece of dry ground can be seen bundles of freshly cut stems, standing to shed their leaves prior to retting. Large, deep water tanks, dug in the earth, are filled with retting bundles, kept submerged by logs of wood, clods of soil and weeds. This soaking process is completed in 10 to 14 days.

Then bundle after bundle is battered and broken; the lower end of each is beaten in water with a flat stick or wooden mallet and the pithy parts of the stems are thereby detached. The man then takes hold of the exposed fibres and, by alternate pushing and pulling with a jerky motion, he gradually withdraws a complete hank from the bundle of rotted stems. Each lot of fibre is rinsed and washed and later hung in the sun to dry.

Machine decortication

It appears that some attempt has been made in India to try out the machine decortication of harvested stalk to by-pass retting, though the results were not conclusive by any means. Some of the trials were

carried out on stalks that had to be shipped to New York or Rome and were, therefore, not in condition to be tried out fairly in the machines used. Only one machine, from Baproma Inc., New York, was imported for use at the Jute Research Institute farm: many makes of machines were not tried, and these included the decorticator now used in South Africa.

Jute belongs to a different botanical family from that of kenaf, though the make-up of the stalk is very similar. The fibre is contained in the ring of bark surrounding the central stick in both plants; so if kenaf can be decorticated or deribboned, there is no reason to suppose that jute stalk could not be treated in the same way.

Reports made mention of the loss of fibre during decortication, which was said to be as much as 26% for the *olitorius* species. Nothing has been said about the loss of short fibres during the ordinary process of retting as carried out by peasant plot-holders, which some authorities estimate to be as much as 30% of the maximum amount of fibre.

Prospects of Mechanisation

It was stated that even if decortication were found to be successful, the prospect would not be very encouraging under Indian conditions, because the holdings of jute cultivators are very small, usually not exceeding 10 acres. In other words, fragmentation of cultivation at present forbids modernisation and the introduction of mechanical aids.

In fact, the main object of the decortication trial was not to ease or cheapen production. It was undertaken because, under the prevailing conditions in the country, it is not easy to get uniform and high-quality jute in most of the jute-producing areas. This is due to a scarcity of skilled labour and, unlike the jute-producing regions of Pakistan, to a lack of clean water in sufficient quantity.

Conclusions

In conclusion, it seems that much more could be done for the primary producers: to encourage them to co-operate and concentrate their holdings; to arrange the financing of price regulation by levies on the export of jute; to make serious efforts to introduce mechanisation.

Coming Events

Agricultural machinery. – The 30th Salon Internationale de la Machine Agricole will take place from 3–8 March at the Exhibition Ground of 'La Porte de Versailles' in Paris. Information from L'Union des Exposants de Machines et D'Outillage Agricoles, 95 Rue Saint-Lazare.

Agronomy. – A Symposium for Agronomists will be held at Rehovoth, Israel, from 13–15 April. The theme will be the Development of Agriculture – the transition from extensive to intensive agriculture. Details from Symposium for Agronomists, P.O. Box 184, Jerusalem, Israel.

Corrosion. – The largest display of anti-corrosion methods ever held in Britain will be staged from 27–30 April this year at the Royal Horticultural Society's New Hall, Westminster, London, S.W.1. Readers of WORLD CROPS may obtain complimentary tickets by writing to the Editor.

Agronomy. – The First World Congress on Agronomic Research will be held in Rome from 7-9 May. Further information from the Organisers, International Confederation of Technical Agriculturists (C.I.T.A.), Beethovenstrasse 24, Zurich, Switzerland.

Agricultural Exhibitions

Italy. – An International Agricultural Fair will be held at Verona, Italy, from 8–16 March. Enquiries to Ent. Fiera di Verona, Palazzo del Pallone, Verona, Italy.

Israel. – The International Farmers' Convention and Agricultural Exhibition is to be held at Rehovoth, Israel, from 29 March–12 April. Further information from P.O. Box 184, Jerusalem, Israel.

New Zealand. – This year the Waikato (Agricultural) Winter Show will be held from 26 May–2 June at Hamilton, New Zealand. Further details from Waikato Winter Show Association, Box 616, Hamilton, New Zealand.

Spain. – Madrid is to be the centre for an Agricultural Exhibition from 28 May–23 June this year. Enquiries to Fl. Comisario General de la Feria, Int. del Campo Ministerio de Comercio, Castellano 14, Madrid, Spain.

Cut stems ready for retting. The stalks attain a height of 6 to 12 ft., with a thickness of ½ in. or less. The mature plants are either cut close to the ground or, if growing in water, are pulled up by the roots

The Grapes and Wines of Bulgaria

PROF. N. NEDELCHEV

Grapes of the Bolgar variety

Vines have been cultivated in the Balkan Peninsula for a very long time, and at the end of the seventh century viticulture was already well developed. In 1884, Phylloxera *destroyed a large part of the vineyards and* 12 *years later the vineyards were replanned and replanted with vines grafted on stocks of American origin resistant to this disease.*

TEN years ago the usual size of a vineyard in Bulgaria was no more than 0.1 to 0.2 ha.* Mechanical cultivation was therefore not practicable; nor could they have afforded it. Vine-growing, as well as farming in general, was primitive and not very profitable.

Today over 80% of the arable land, including the vineyards, has been combined into co-operative farms. These are collective farms organised on a socialist pattern and with voluntary participation; they include over 80% of the peasants. They have the full support of the State, and are encouraged to increase their planting and to use machines.

A growing industry

Some of the old vineyards have been uprooted and replaced by large areas of vineyards more suitable for machine cultivation; 44,000 ha. of such vineyards have been planted up to 1956 and thousands of hectares of new land are being planted with vine seedlings each year. About 3.5% of the arable land in Bulgaria is at present planted with vineyards.

The prospects of a further increase in the export of grapes and grape products open up a bright future for the development of viticulture. By 1965 the vineyard area in Bulgaria is expected to reach 250,000 ha., 35,000 ha. of which will be planted with the Bolgar dessert variety. In the next few years 15,000 ha. of high-quality foreign varieties of wine grapes will be planted mainly for the production of white wines.

*1 ha = 2.471 acres

Varieties of grapes

About 150 varieties of wine and dessert grapes are grown in Bulgaria today. About 100 are local varieties, the others having been brought from other countries when, at the close of the last century, the vineyards, destroyed by *phylloxera*, were replanted. The new vineyards of the co-operative farms are being planted with pure line varieties.

Bulgaria can be divided into five vine-growing districts according to the more important wine varieties: North Bulgarian, South Balkan Valley, Rila-Rhodopes, Black Sea and Pirin districts.

The areas planted to the various grape varieties are given below as percentages of the total area under cultivation:

1.	Pamid	23.8
2.	Gumza	11.6
3.	Bolgar	11.2
4.	Dimyat	10.3
5.	Red Muscat	3.5
6.	Vinenka	2.3
7.	Mavrud	2.1
8.	Chaush	0.3
9.	Directly planted varieties	11.4
10.	Other varieties	23.5

Of the more important varieties of grapes shown above, Bolgar, Chaush and Dimyat, which are used for wine, are also exported as fruit.

Their disposition

The *Bolgar* variety is grown in northern as well as in southern Bulgaria and is the most valuable variety of dessert grape cultivated in the country. Its bunches are large and cone-shaped, with long amber-coloured grapes and an average weight of 270 g. Its sugar content ranges from 18% to 20% and its acidity from 4.2% to 4.8%. This variety is not easily perishable and may therefore be transported over long distances.

Much care is taken in its cultivation. The vines are placed on a wire network and pruning is done on the Guyot system. In many co-operative farms, where scientific methods are applied, high yields are obtained. Thus, for instance, the co-operative farm of the vine-growers' village of Grozden, Polyanovgrad county, obtained an average of 12,000 kg. of grapes per ha. from 2,200 ha. of unirrigated land. Remarkable yields have been obtained in some small areas. Thus, on the Perushtitsa co-operative farm in Plovdiv county 53,700 kg. of the Bolgar variety of grapes per ha. were gathered from 0.3 ha.

The *Chaush variety* is grown mainly in Plovdiv county. The area planted with Chaush along the Danube and in some districts of South Bulgaria is also to be extended. This variety requires the same conditions and methods of cultivation as the Bolgar grapes.

The clusters of the Chaush are large with an average weight of 210 g. The grapes are large, egg-shaped, fleshy, with a tender skin of a yellow-green colour. They have a delicious taste

with a slight but distinctive aroma. Because of its tender skin, this variety is not so suitable for export as the Bolgar, which is not so easily damaged. The sugar content of the Chaush is 16% to 18% and its acidity is quite low – 3% to 4%.

The *Dimyat grape* is grown mainly in north-eastern Bulgaria. Its clusters are large with an average weight of 210 g. The grapes are smaller than those of the Bolgar, slightly oblong, with 18% to 20% sugar content and a comparatively high acid content – 5% to 7%. In its suitability for export it comes between the Chaush and the Bolgar. A considerable extension of the area planted with this variety is expected. It will be used mainly for wine making and for home consumption, since it is suitable for winter storage. The Dimyat is very high yielding and is easily cultivated.

The most universally grown is the *Gumza red grape*. The typical Gumza red wines are made mainly in northern Bulgaria. Gumza grapes are grown in some neighbouring countries, such as Yugoslavia, under the name of Skagarka, and in Hungary, under the name of Kadarka. High-quality red wines with a comparatively high alcohol content, sufficient general acidity and colour are made from this variety.

Slightly tinted red wines, known as Pazardjik wines, are made from the *Pamid variety*, cultivated in the Rila-Rhodopes district, along the River Maritsa. The best of them is the Karabunar wine, which has a slight flavour of raisins. The Pazardjik wines are quite strong in alcohol, but their acidity is low and makes them unsuitable for long storage. The Mavrud variety, from which the best Bulgarian red wines are made, is grown in the Plovdiv and Assenovgrad counties.

A Bulgarian girl bearing a tray of Bolgar grapes

The *Mavrud wines* have a very high alcohol content, good acidity, and are well coloured. The Mavrud wine is used together with the Pamid wine for making a type of red Trakia wine for export.

Vine varieties, such as *Pamid*, *Dimyat*, *Red Muscat*, *Vinenka*, *Shevka* and the like, are mainly cultivated south of the Balkan range.

The *Red Muscat* is the basic variety from which the Karlovo and Sungulare white Muscat wines are made. They have quite a high alcohol content, a freshness, and a fine muscat flavour. These are some of the best white wines made in Bulgaria and are chiefly exported.

The most widespread varieties in the Black Sea district are the *Pamid* and *Dimyat*, of which light red Pamid and white Dimyat wines are made. High-quality vines, such as Italian Riesling, Aligote, Ugni white, Kokorco etc., are to be planted in this district to improve the Bulgarian white wines.

Mainly two varieties are cultivated in the Pirin district: the *Melnik* for the preparation of red wines and the *Keratsuda* for the preparation of white wines. The Melnik red wine is known for its high alcohol content, good general acidity, high dry extract and fine colour. The typical Melnik wine contains also about 10–15 g. of residual sugar per litre, which gives it sweetness. In the Pirin district small quantities of white wines are made of the Keratsuda variety. The white wines have a high alcohol content and low acidity. The tests made to obtain white wine of the sherry type made of Keratsuda grapes have yielded encouraging results.

In the Podgorie locality west of the town of Petrich the vines are cultivated on living trees, as is done with vines in Italy. The main dessert variety in Petrick county is the *Red Parpak*.

Foreign varieties

The extension of the foreign dessert varieties, Perle de Ksaba, Reine des Vignes and Chasslas dore, used mainly for consumption, has been encouraged in the last few years. Planting of foreign varieties of wine grapes has also been encouraged. Such are the white grape varieties, Riesling Italien, Aligote, Ugni white, Rkatsiteli, Furmint, Hars develu, Feteasca alba, Feteasca regala and other varieties. The following red grape varieties are also to be planted: Cabernet Sauvignon, Pinot noir and Saperavi.

Wines and wine-making

Bulgaria produces red and white dry wines, white semi-sweet wines, sweet dessert and strong distilled wines for

A wine cellar in Bulgaria. Young wine is drawn into wooden casks where the fermentation is completed and the wine allowed to cool

the preparation of cognac spirit and grape brandy. Small quantities of grape juice and grape concentrate are also prepared.

The grapes are processed into wine in the cellars of the Vinena Promishlenost (Vinprom) State Economic Enterprise, of which there are branches in all the more important growing areas. In some of them the wine cellars have a capacity of over five million litres.

In the preparation of *red wines* the grapes are crushed and placed in the fermentation vats, where they are treated with sulphur dioxide, high-grade barm being added. The wine is drawn one or two days after the violent fermentation has ended and the relative weight (sp. gr.) of the wine falls to 1,000, according to the Dugardin mustmeter. Then the young wine is drawn into concrete reservoirs or wooden casks, where the fermentation is completed and the wine is allowed to clear.

The *white wines* are prepared by crushing the grapes in the press and the 'marc' is passed through a rotating drainer. The marc then falls into the receptacle of the hydraulic press, where 'must' is expressed from it. The must obtained from the drainer and the press is mixed together in vessels and cleared by sulphur dioxide. The clear must is then removed into the fermentation vessels and barm is added. The fermentation of white wine takes longer than does the red. When the violent fermentation ceases and the young wine is partly fined, it is removed to other vessels, where it is stored until required for consumption.

Dessert wines are prepared from grapes with a high sugar content by stopping the fermentation of the must with a 96% spirit or grape concentrate. The sweet red dessert wines are prepared from the Gumza, Mavrud, Melnik or Pamid vine varieties with over 21% sugar content. When the sugar content of the crushed grapes is below 24% it is fortified with grape concentrate.

The grapes are crushed and allowed to ferment. When the sugar content falls to 19% the must is drawn out of the vat and the necessary quantity of 96% spirit, calculated according to special tables, is added. The ready wines have the following composition: alcohol 16° to 16.5°, sugar 16% to 16.5% and acid titre from 3–6 g. per litre.

Strong red dessert wines are prepared from the same grape varieties as the sweet red dessert wines. The technology of their production is the same, the only difference being that the fermented must is drawn from the skins of the pressed grapes when the sugar content falls to 13%, after which spirit is added. When ready, the wine contains 18% to 18.5% alcohol, 10% to 11% sugar and its general acidity is 3–6 g. per litre.

White dessert wines are prepared from white grape varieties, such as the Red Muscat or Dimyat, with a sugar content of over 24%. The grapes are crushed and the must expressed. Up to 4% to 5% of spirit and sour fermented wine is added to start the fermentation. At the beginning of the violent fermentation three-quarters of the necessary spirit is added, including the quantity added in the beginning. The rest of the spirit is added when the sugar content falls to 17.5%. When ready, this wine contains 16% to 16.5% alcohol, 16% to 16.5% sugar and has an acid content of 3–6 g.

The *strong white dessert wines* are prepared from the same varieties and with the same technology, the only difference being that the final portion of spirit is added when the sugar content has fallen to 13%. When ready, this wine has the following composition: 18% to 18.5% alcohol, 10% to 11% sugar and general acidity of 3–6 g. per litre.

Sweet and strong dessert wines are prepared from the Tamyanks Muscat variety. Dessert wines are allowed to mature for a few years in small barrels.

Owing to the excellent qualities of the grapes, Bulgarian wines are much appreciated in foreign countries and they have been well received in Russia, Czechoslovakia, the German Democratic Republic, the Federal German Republic, Poland, Austria, Switzerland and Finland.

News from FAO

The Director-General of FAO, Mr. B. R. Sen, of India, welcoming Dr. Norman Wright

News has been received that the Council of FAO has appointed Dr. Norman Wright to be Deputy Director-General of FAO. He has long been associated with the work of the organisation and was Chairman of its Programme Committee. Dr. Wright will be remembered as the first Director of the Hannah Dairy Research Institute in Scotland (1928–47). *He has travelled widely; he advised the Government of India in* 1936, *the Government of Ceylon in* 1945, *was a member of the Scientific Advisory Mission to the Middle East in* 1944 *and was the British member of the FAO mission to Greece in* 1946

New Publications

Mushrooms

By A. Pilat. Pp. 340, with 120 plates in colour by O. Usak. London: Spring Books. 1958. 50*s*.

It is popular practice to divide the higher fungi into two groups – mushrooms and toadstools, the former being edible and the latter either poisonous or unsuitable for eating. Actually no such sharp distinction is possible. In this book Pilat uses 22 expressions to describe the gastronomic or poisonous qualities of some 150 varieties of mushrooms. These range from 'excellent edible' for *Marasmius oreades* (Fairy Ring) *to* 'fatally poisonous' for the deadly *Amanita phalloides*, the innocuous-looking Death Cap mushroom, which can so easily be mistaken for that tasty field and orchard mushroom, *Agaricus arvensis*, the so-called horse mushroom, which Pilat considers to be 'the best of all champignons'. In between there are many species which, though not directly poisonous, taste acrid or bitter, or are otherwise unpleasant.

It is reassuring that the number of poisonous mushrooms is quite insignificant in comparison with the number of edible or harmless species, but those usually described as 'edible' are not all equally tasty; some are tough and indigestible, and some have so little body as to be of no culinary value. In this book Pilat gives his own opinions, based on many trials of the non-poisonous varieties, but he is not dogmatic in his verdicts, for he comments that there are no two mushroomers who agree exactly on the qualities of the different species.

Perhaps the most interesting fact that emerges from this work is that the gathering of wild mushrooms is a considerable industry in Czechoslovakia, where mushroomers are guided by the *Codex alimentarius* of 1937, which lists 58 species of mushrooms which it is permitted to market in that country. Furthermore, their operations are controlled by a Ministry of Health Regulation, No. 586 of 1950, which defines the conditions under which mushrooms may be collected, preserved, marketed or converted into manufactured products.

The supreme value of the book lies in the excellence of the water-colours by Usak and the detailed, concise and yet exhaustive descriptions of each species by Pilat, which, taken together, will prevent the 'amateur' mushroomer and even the expert from making unfortunate mistakes. These delightful paintings of the fresh living material, in various stages of growth, took six years to produce and are a triumph of patience, enthusiasm and good teamwork between the mycologist and the artist.

This book will have a very wide appeal. For the mycologist it is an authoritative textbook on the higher fungi, as it includes an account of the morphology, biology, anatomy and histology of the higher fungi; for those engaged in the industry it will provide a mine of information; and for the naturalist and student it is a most pleasing, accurate and serviceable book of reference.

F. C. COOKE

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Technical Books,
308 Euston Road,
London, N.W.1.
Telephone: Euston 5911.

Other miscellaneous publications reviewed should be obtained direct from the addresses given.

The Seychelles Coconut Industry

By F. C. Cooke. Pp. 57, with map and bibliography. Government Press, Victoria, Mahé, Seychelles.

This report, following a tour of the Seychelles Islands at the request of the Government, written by Mr. Cooke, formerly Director of the Coconut Research Institute of Ceylon, is well worth careful reading, not only by those interested in the Seychelles industry, but by all who are interested in coconuts and copra production anywhere in the world.

It describes the industry as it is at present and the reasons for a decline in production of recent years, mainly due to erosion on the upper and lateritic slopes, to the need for terracing, for more attention to manuring and the conservation of the organic content of the soil. It points to the need for replanting, for more vigorous control of the chief pest, and to the rejection of unsuitable land.

The chapters on recommendations prove that an expert has voiced his views for the benefit of the industry. The way in which seed-nuts should be selected, and the advice given regarding nursery treatment and replanting, is particularly sound. The author has not suggested the importation of seed-nuts from elsewhere, but has wisely pointed to the value of selection from local ecotypes which have proved adaptable to Seychelles conditions.

Again, in his discussion on the incidence of *Melittomma* borer beetle, it is suggested that the chief cause of increasing trouble has been the unthrifty nature of ageing palms and lack of sufficient nutrients. The history of borer beetle attack on other plantation crops usually starts when crops have been grown in unsuitable environments, or have become unthrifty for one cause or another.

Unfortunately, the report is marred by a number of misprints.

A. E. HAARER

Commercial Fertilisers and Soil Management

By F. Leheis (Dresden), H. Peter (Leipzig), H. Dachsel (Dresden) and W. Selke (Berlin). Pp. 69, illustrated. Bergbau-Handel, Jagerstrasse 55, Berlin, W.8. 1958. In English. Price not stated.

The title of this book is misleading, for it is simply an account of a routine soil testing service that is operating in East Germany. Although there is nothing new or original in this book, it will be of interest to those engaged in soil testing and its application to crop production in other countries. It is, however, interesting to note that soil testing has been imposed on the farmer as a compulsory service.

Colonial Development and Research

Colonial Research, 1957–58, Cmnd. 591. H.M. Stationery Office. 1958. 14*s.* 6*d.*

Grants totalling £1,123,850 have been approved for 85 new Colonial Research Schemes and 54 Supplementary Schemes in 1957–58, states the report of the Colonial Research Council. About 35% of the gross allocation is for agricultural, animal health and forestry schemes, 8% for pesticides research and 3% for anti-locust research. Regionally 38% of the allocation is for schemes to benefit East African territories, 17% for the West African group, 8% for S.E. Asian territories and Hongkong, 12% for the West Indian territories, 5% for Northern Rhodesia and Nyasaland, and 20% for other territories.

Colonial Development Corporation. A pamphlet giving an account of its investments and activities. London. 1958. Free.

The Board is charged with the duty of investigating, formulating and carrying out projects for developing the resources of colonial territories with a view to the expansion of the production of foodstuffs and raw materials and the development of agriculture, industry and trade therein. To carry out these projects the C.D.C. has powers to borrow up to £150 million on long-term and £10 million on short-term. The Corporation operates on a commercial basis; it must pay interest on its loans from Government and must pay its way.

The head office is in London and there are regional offices in the Caribbean area, the Far East, East Africa, Central Africa, South Africa and West Africa. Projects include public utilities, factories, mines, forests, plantations and smallholder schemes. Some projects are managed by the Corporation; some in association with private enterprise; and some take the form of loans to Government organisations, or industrial firms. In addition, any Commonwealth government can now call upon the C.D.C. to manage or give advice in development projects.

At 30 June, 1958, there were 77 projects in hand and the capital approved and committed at that date for continuing projects totalled £81,833,000 and many new schemes are still under examination.

F.A.O.

The Potential Contribution of Atomic Energy to Development in Agriculture and Related Industries. By R. A. Silow. Pp. 23. Rome. 1958. Available on request in English, French and Spanish.

The present use and the future potentialities of radiation in food preservation and processing, and in plant breeding, and the proved and constantly expanding role of radio-isotopes in agricultural research are the subjects discussed in this brochure. The author states that present experience indicates that irradiation of food may make an important contribution to available food supplies by helping to reduce the serious losses that occur at all stages between production and consumption, but he makes certain reservations under which radiation techniques should be employed in food preservation and plant breeding programmes. No such reservations appear to be necessary in the case of radio-isotopes in agricultural research and all countries can benefit immediately from the use of this technique.

Ha-Gan L'lo Adamah (A Garden Without Soil)

By W. Frankl. Pp. 104, illustrated. Tel Aviv: Hadar Books. 1958. In Hebrew. Price I.L. 3,500.

This is the first book on the subject of hydroponics written in Hebrew and it is a subject which is of particular importance to Israel, because two-thirds of the country is non-arable, there is a surfeit of sunshine, and an ample supply of the necessary plant nutrients.

The Jewish Agency and the Ministry of Agriculture have established a Hydroponic Experimental Station near Beersheba and there is a small hydroponic farm at the Home for the Aged in Holon. The subject is also being pursued vigorously in a number of schools under the direction of the Ministry of Education.

The book is well illustrated with photographs and with drawings by Brigitte Frankfurter and, except for one or two small mistakes, is carefully presented.

Fruit Annual, 1959

This reference book gives comprehensive information on world production of and trade in fresh, dried and canned fruit and fruit products.

The first section opens with a survey of crops, sales and consumption during the past year in the important fruit-growing countries. Other chapters cover the mechanisation of fruit growing, processing and packaging, transport of fruit by air, fruit shipper's guide, and a fruit supply calendar.

The directory section gives details of more than 5,000 firms engaged in the production, packing and processing of fresh and processed fruit, covering more than 60 countries.

Obtainable from British-Continental Trade Press Ltd., 222 Strand, London, W.C.2. Price 20*s.*

Books on Agriculture and Horticulture

Bulletin No. 78. Pp. 96. London. H.M. Stationery Office. 1958. 6*s.*

This is a useful catalogue of some 2,000 books, mostly post-war productions that are to be found in the library of the Ministry of Agriculture of Great Britain. It gives details of the author, the title, the publisher, and place and date of publication and other essential information. These works may be consulted in the Ministry's library at Whitehall Place, London, S.W.1, and the list will be of interest to all engaged in agriculture and market gardening, and to librarians, colleges, teachers and students.

H.M. Stationery Office

Wheat. By D. H. Robinson, PH.D. July 1958. 2*s.* 8*d.*

Sugar. Draft International Sugar Agreement as adopted at the Final Plenary Meeting of the United Nations Sugar Conference, Geneva, 22 September to 24 October, 1958. Miscellaneous Publication No. 16, 1958. 1*s.* 8*d.*

Colonial Reports, 1956 and 1957, The Gambia, 6*s.* 4*d.*; 1957, Northern Rhodesia, 5*s.*; 1956, Basutoland, 6*s.*

Forest Working Techniques and Training of Forest Workers. Provisional Protocol for the Testing of Forest Tractors (revised). 4*s.*

Timber Bulletin for Europe, Vol. XI, No. 2, Production, Trade and Price Statistics, January to June, 1957 and 1958. Market Review to 31 August, 1958. With Supplements Nos. 3 and 4. 7*s.* 7*d.*

A battery of 36 100-ton aluminium grain silos, fabricated in Noral alloys by Frederick Braby & Co. Ltd., in conjunction with Northern Aluminium Ltd.

Cereal and Grain Handling Equipment

An auger instead of a blower is used in this combined mill and mixer unit

Mill Mixer Without a Blower

In recent years considerable attention has been paid by farmers to ' on the farm ' mixing and grinding of all types of animal food.

After considerable research, *Wolseley Engineering Ltd.* have succeeded in producing a unit, the ' Multi-Mill ', in which the mill and mixer have been built together as one integral unit, using an auger instead of a blower to move the meal from the mill and at the same time to provide constant mixing.

Apart from its compact and neat design, this system has two great advantages – less air and less waste of power. The minimum amount of air is drawn in with the grain, since no fan or blower is fitted, and it is necessary to use only one small dust sack, which is self-emptying into the additive hopper. This results in perfect dust-free grinding with no danger of tube blocking. In addition, the tiresome whine of a blower is absent and the unit runs more silently.

Only one 3-h.p. motor is required, as the hammer mill demands virtually no starting effort, and once the mixer is rotating its power requirement drops sharply and the major part of the power can then be used for the mill.

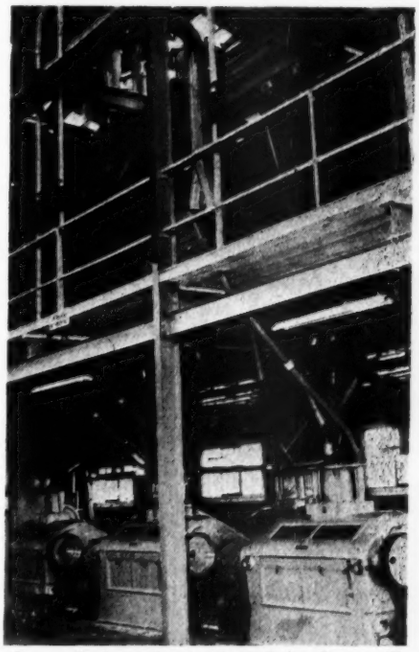
Improved Flour Mill Design

A revolutionary new design of flour mill has just been started up at Dalby in Queensland, Australia. The mill has only two floors, as against the conventional four- or five-floor building, and the actual floor space has been cut by well over 50% per unit of capacity, resulting in a considerable saving in building and plant expenditure, which has enabled the operating company to cut the cost of their flour by an initial 10*s.* a ton.

Developments in roller mills, sifters and purifiers and the introduction of pneumatic conveying to handle the grains have made possible this tremendous saving in capital expenditure. The mill is owned by *Barnes Milling Ltd.* and its design and execution was a combined operation by *Thomas Robinson & Son Ltd.* and its Australian subsidiary.

New Coffee Drier

During the past year *American Drying Systems Inc.* have been experimenting with an entirely new type of coffee drier. The new machine is now in production and in use on coffee farms in Central America. The 1959 A.D.S. driers are available in four sizes, with capacities ranging from 7,500 lb. to 60,000 lb. dried beans in 24 hours. It is claimed that the new drier is more efficient in that it uses less fuel, dries in a shorter time and produces a better product than has



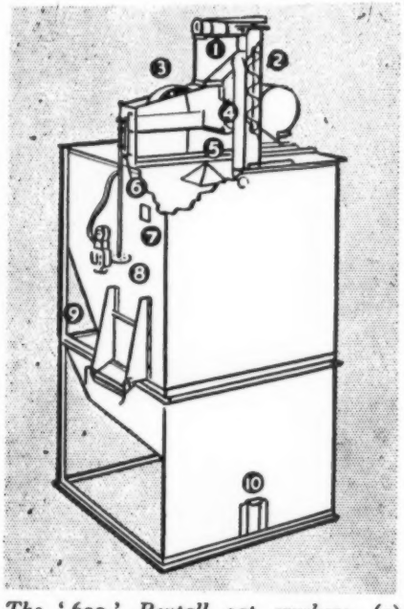
General view of a section of the flour mill at Dalby, showing the Robinson roller mills, with the direct lift of the flour by high-pressure suction to the cyclones set in the apex of the roof; the plansifters and purifiers are arranged on the first floor

hitherto been possible with the usual drum driers.

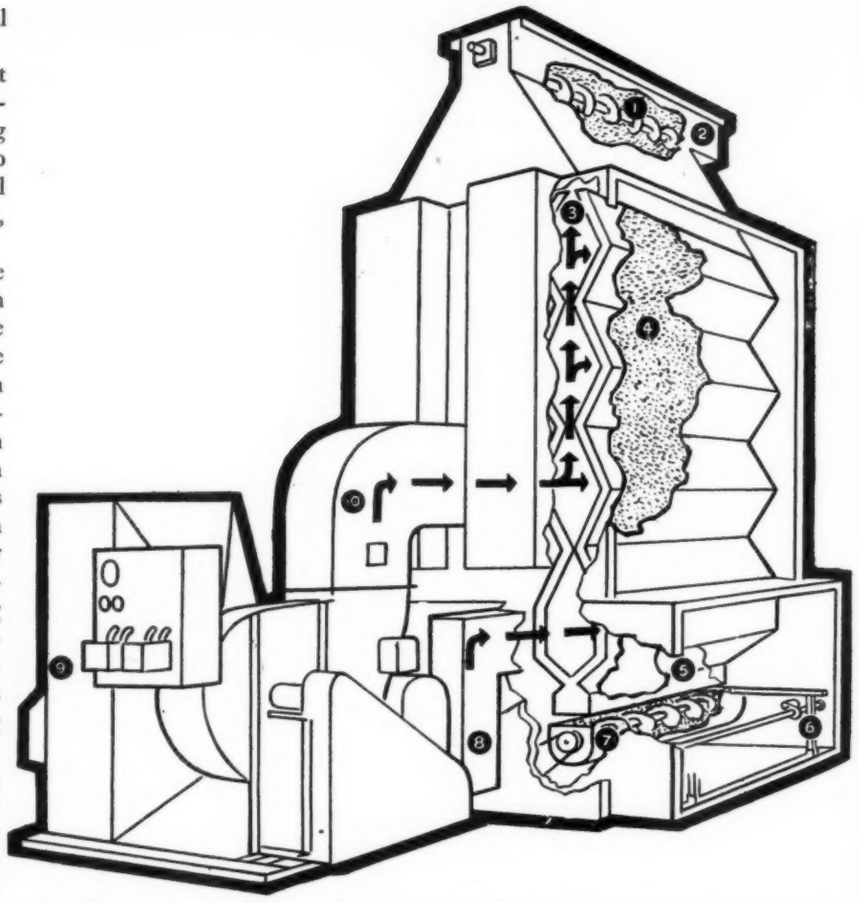
In this model the main heating unit has a diesel oil burner with a high-refractory combustion chamber, giving a fuel efficiency of 98.8%; there is also an auxiliary unit to provide additional heat which burns coffee pulp and hulls, and also wood fuel.

The drier is of the columnar type and the drying column is fitted with *screen* tumblers, so that the coffee beans are exposed on all sides to the warm air, which after passing through is returned to the air-heater and re-circulated over and over again. In time, of course, it becomes warm humid air and this prevents the beans from becoming case-hardened, which can occur at this stage with hot, dry air. The drier is fitted with automatic controls, so that the circulating air is maintained at the correct temperature and the correct moisture content. This system naturally conserves fuel and materially reduces the drying time.

The net drying time with drum driers is about 24 hours; with the A.D.S. drier it is only six hours, the beans receiving three treatments. In the first passage, after washing, all the surface moisture is evaporated and the moisture content is reduced from 52½% to 35% in 1½ hours; this batch is then held in a storage bin for 12 hours to allow the moisture content to equalise; it is then again placed in the drier for another 1½ hours, which reduces the moisture content to about 20%; the batch is once again stored, this time for 24 hours; and finally the beans are sent through the machine and recirculated until they are properly dried – usually about three hours.



The '600' Bentall oat crusher: (1) *feeding hopper,* (2) *elevating auger,* (3) *crusher,* (4) *overflow return chute,* (5) *spreader,* (6) *screw adjuster for rolls,* (7) *sampler,* (8) *receiving hopper,* (9) *loading hopper,* (10) *feed inspection door*



The 'Vertiflow' grain drier: (1) *feeding auger,* (2) *overflow return chute,* (3) *plenum chamber,* (4) *falling grain,* (5) *cooling section,* (6) *grain-flow control,* (7) *delivery auger,* (8) *cool-air duct,* (9) *control panel,* (10) *hot-air duct*

The elevating and conveying system within the drier operates at a very slow speed and handles the beans very gently, and the overall effect of all this careful processing is that the coffee beans are uniformly dry, uniform in colour, undamaged and free from spotting.

Oat Crushing

The new *Bentall* automatic oat crusher is a robust machine, which is simple to operate and easy to maintain; its output is high and the degree of crushing can be controlled to fine limits. There are two models, one with an output of 600–1,000 lb. per hour, and the other which will deliver from 800–1,800 lb. per hour.

The grain is loaded into the bottom hopper of the unit and lifted into the feeding hopper by means of a worm auger, driven off the shaft of the crusher. An overflow return pipe prevents spillage of grain through over-feeding.

The grain immediately passes through the crusher into the receiving hopper. A spreader is fitted to disperse the crushed material as it is ejected from the rollers. Attached to the spreader is a two-way cut-out switch, which operates in case of underload, *i.e.* if the feed hopper is empty, and in case of overload, *i.e.* if the receiving hopper is over-full.

A quick-release mechanism is provided to keep the rolls apart approximately 1 in. to allow stones and foreign bodies to pass through.

Grain Conveying and Storage

J. W. Woolley & Co. are manufacturers of grain-drying, conveying, elevating and storage equipment. Their continuous-flow 'Vertiflow'

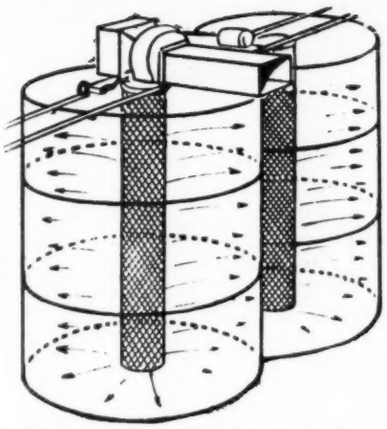


Diagram of a Simplex silo, showing the arrangement of the overhead ventilating unit and the hollow ventilating core. The discharge or sacking-off chutes are not shown

driers are designed for outputs of 30 cwt. and 3 tons per hour respectively, and to extract 5% of moisture at 160°F. The rate of flow through the drier is constant, but the rate of discharge can be varied to meet requirements. Thermostatic controls are fitted to both hot and cold air flows to ensure safety in case of flame or fan failure.

The wet grain is fed in at the top of the machine and is distributed by slow-speed worm conveyor into the drying chamber, any overflow being returned. The grain falls in a 4½-in. stream against a blast of rising hot air and is cooled and discharged by another worm conveyor at the bottom.

The dried grain can then be carried either by chain or belt conveyor to the boot of the Woolley bucket elevator and so delivered to the new Woolley grain storage bins, which are of special design for easy handling and assembly. These bins can be supplied in single or multiple units, and with or without central tunnel arrangements.

Silo Drying

The combine-harvester has made harvesting more efficient and economical, but has introduced a new problem – drying and storage of the grain. There are various systems available, but plant and installation costs are generally greater than the average farmer can afford. The 'Simplex' drying system has been developed by a practical farmer, and provides a most economical answer to the problem. The initial cost is low and the system can be installed by the farmer himself and it needs no special buildings to house it.

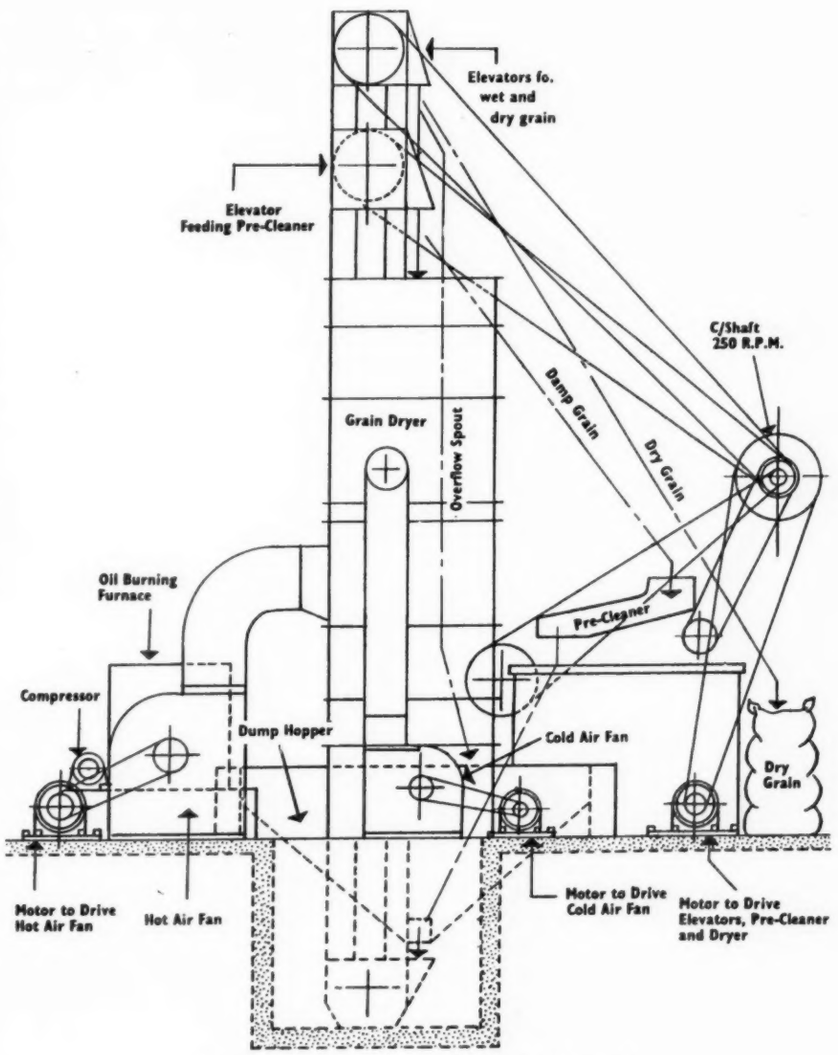
The system involves the use of expanded metal to form the silo walls. This effectively holds the stored grain while permitting maximum air ventilation, since it provides 460 vents per sq. ft. A further advantage is that the weight of silo material per ton of grain capacity is only 40 lb. The material is delivered by *Messrs. Agricultural Supplies (Cambridge) Ltd.* in flat panels, 8 ft. wide, and it can be erected by unskilled men on any level site. No special foundation or floor connections are necessary and a 12-ft. × 10-ft. silo can be erected by three men in one hour. Conversely, it can be dismantled and stored away should the space be required for other purposes.

For the farmer with only a small tonnage of grain requiring to be dried and stored, a fan and heater unit, mounted on top and blowing downwards into the cylinder, is the answer. The fan and heater unit being portable makes it a simple operation to transfer it to the next silo while the first is being emptied. The ventilating air is blown into a hollow core, passes through the grain and out through the walls. It is to be noted that the type of expanded metal used allows this through ventilation from the whole surface of the silo without losing any grain.

Automatic Grain Drying

The *Porteus* grain drier consists of a column with walls or compartments in the form of a square, and it is built in sectional units.

The wet grain is fed by gravity from elevator, conveyor or bin to the top receiving chamber, which spreads



Typical layout of a Porteus grain-drying unit

Adding an extra section to the basic unit of the Quicklift grain conveyor

it to the four walls of the heat section.

Hot air is compressed uniformly into the central chamber by a suction fan drawing air from a furnace or heater, and passes through the heavy-gauge galvanised steel perforations, forming the central square chamber, through the walls of grain and finally through the heavy-gauge galvanised steel perforations forming the outside walls.

A feature of this drier is that at approximately half-way in its passage through the hot section the grain is automatically turned, *i.e.* a complete reversal of the inner and outer grain walls.

The cold section is of similar construction to the hot section, but in this case air is drawn by the cold air fan from the atmosphere the full depth of the section, through the outer perforations and the walls of grain into the separate central chamber; from here it passes through the cold air fan to the outside air.

The discharge is by one ratchet motion connected by gears to the four fluted feed rollers at the base of each grain wall. This motion is quickly and easily adjusted to give varying speeds to the feed rollers to govern the downward speed of the grain in the walls, according to the moisture content. In this way a continuous and even flow of dried grain is delivered to the discharge hopper from each of the feed rollers.

The driers have capacities ranging from two to five tons per hour and are designed to reduce the moisture content from 22% to 16%.

Air-heating Unit

The 'Aero-Trol' is a lightweight and portable gas-fired heater with an output of up to 250,000 B.T.U. per hour and designed to supply heated air to supplement natural air-drying on cold and humid days. The unit has a built-in fan and automatic controls.

Besides its use in crop drying, the machine can be used to heat workshops and dairies, and horticultural and farm buildings. The manufacturers are the *Aerovent Fan & Equipment Inc.*, of U.S.A.

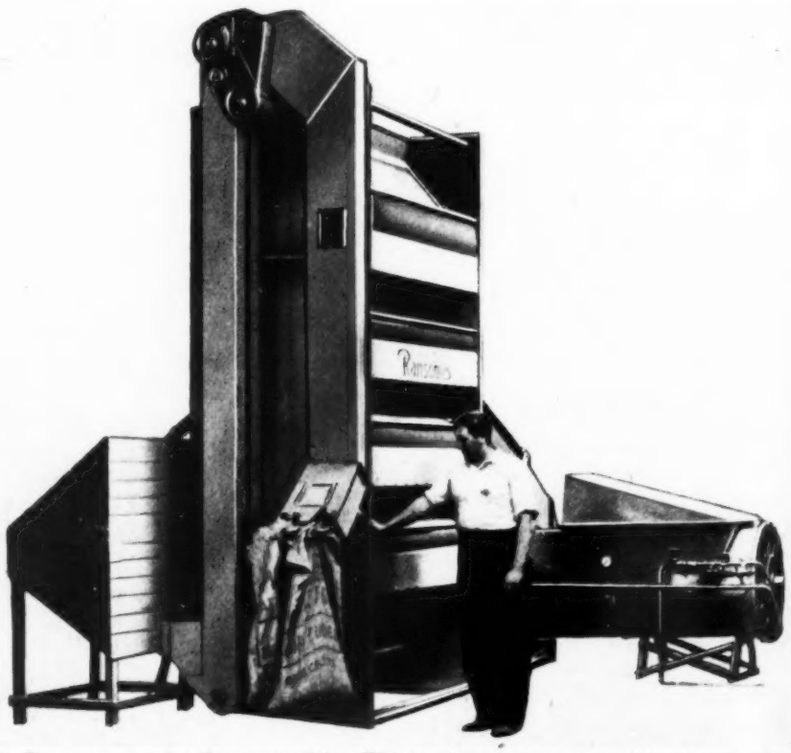
A Penney & Porter continuous tower-type drier installed in a Dutch barn. It includes a pre-storage bin, a pre-cleaner and a sack weigher, and it has a capacity of 4 tons per hour

Extendible Conveyor

The 'Quicklift' grain conveyor, which is made by *Opancol Ltd.*, is extendible in length from 9 ft. to 25 ft., according to requirements, and it will deliver up to 11 tons per hour without damage to the grain. The conveyor screw is carried in 4-in. reinforced steel tubing, and both screw and the casing are made in sections, which can be easily carried and joined, and operated by one man. Obvious uses of this screw conveyor are for emptying from, or transferring grain into, lorries; for transferring grain from the cleaner and up into the silo or granary; for turning the grain during storage; or for elevating grain up into a hopper for sacking off.

Grain Storage

A pre-storage bin of 'hot-dip' galvanised sheet construction, suitable both for internal and external use, and consisting of a hopper-in-trough formation, with three hopper outlets, was recently announced by the *Crittall Mfg. Co. Ltd.* The bin stands on four steel stanchions with the hopper base 12 ft. above ground level, which gives ample clearance for lorries and makes it possible for them to take delivery of 10 tons of grain in a few minutes.



The Ransomes gravity-flow grain drier. This continuous three-stage drier (pre-heating, drying and cooling) is offered as a complete installation

Agricultural Chemicals

Insecticides; fungicides; growth regulators; hybrid wheat variety

Protection of Stored Grain

In the major grain-producing countries – America, Canada, India, Argentina and Australia – immense stocks of wheat and coarse grains are being held in long-term storage and the protection of these surplus stocks is an important matter. In Britain alone, preventing the loss of as little as ¼% of the 17 million tons of stored grain and oilseeds would save the nation at least £1 million.

An insecticide, which is lethal to insects, but harmless to humans and animals, has been developed by the *Cyanamid Company* for the protection of stored grain or oilseeds. This product, which is called 'Malathion', can be mixed as a powder with the grain or seeds, or sprayed as a liquid on to the bags, the walls of silos, and the holds of the ships, which carry this produce. Its use for this purpose has been approved by the British, Canadian and American Governments.

Wheat Bulb Fly

In Britain one of the most destructive pests of growing wheat is wheat bulb fly. From eggs laid on bare ground in late summer larvae emerge early in the following year and tunnel into the 'bulb' of young wheat plants, destroying the shoot. The effect of this damage may seriously reduce the yield, if weather conditions do not favour the rapid recovery of the crop.

The importance of the pest varies in different areas; attacks are most common in East Anglia, the East Midlands and parts of Yorkshire and Scotland, but the severity of the attacks varies from year to year. This year there are indications of a high wheat bulb fly egg count, so next season's attacks are likely to be severe.

Late-sown crops are the most vulnerable and, since many farmers have had to delay their sowings owing to the wet autumn, it is recommended by *Bayer Agriculture Ltd.* that winter wheat seed should be dressed with 'Ceresan WB'. This product contains a high proportion of gamma-BHC, which gives full control of the pest and also of wireworm and other seed-borne diseases in a single application.

As it also contains mercurial compounds, it needs to be handled with care and the instructions for its use must be followed implicitly.

Retarded Growth

We have all heard of the use of tranquillisers for soothing humans and for quieting excitable animals; now from America comes news of a plant tranquilliser, which is being manufactured and marketed by the *Rainbow Color & Chemical Co. Inc.*

Its effect on plants is to retard growth and delay flowering. It will induce short internodes, thick stems and dark green leaves. In suppressing stem elongation, it has little effect on the development of the florets; in other words, it will produce miniature plants with little, if any, change in the size of the blooms.

Thus many large plants, regardless of their normal and natural growth characteristics, can now be considered as possible pot plants. Furthermore, there are many varieties of ornamental plants which are too tall to give the correct ratio of pot to plant or else will require protective staking and occupy a great deal of space in storage and transportation.

The dwarfing of trees and flowering plants is a remarkable feature of Japanese horticulture and production of miniature gardens is a traditional art. Plants are dwarfed so that they remain measurable in inches, even when they may be scores, and in some cases hundreds of years old – and the proportions of leaf, branch and stem are preserved with fidelity.

Similarly, the application of this new product appears to offer immense possibilities for an entirely new field of horticultural production and marketing – the production of miniature shrubs and flowering plants for window boxes, verandah gardens and conservatories for people living in crowded cities and towns. There are also possible applications in research.

Control of Leatherjackets

Further to the note on page 378 of the October issue, there are, in addition to those mentioned, two other efficient non-tainting chemicals which can be used for the control of leatherjackets, *Tipula* spp.; they are aldrin and dieldrin, which have to a great extent superseded BHC and DDT.

Aldrin is more volatile than most of the other hydrocarbon insecticides and is used for foliage applications when a short residual action is required and to promote a rapid kill. Because of its relatively high vapour pressure, it is also very effective in its control of soil pests and, when it is incorporated in the soil, it has a long residual

Rainbow plant tranquilliser will keep most varieties of potted chrysanthemums miniature in size without affecting the size of the bloom. L. to R.: *Control*, 100 *p.p.m.*; 500 *p.p.m.*; 1,000 *p.p.m.*

effect – as much as two years from the time of application.

'Aldrex 30' – a *Shell* product – is a miscible oil containing 30% of aldrin in a suitable base oil for application either as a spray to growing crops, or to the soil before planting, or as a poison bait to destroy the grubs. This formulation is also used for the control of wireworm, cabbage root fly, chafers, cutworms, turnip gall weevil and narcissus fly.

Accelerated Flowering

An interesting technique for advancing the flowering of certain types of pot plants, so as to catch the Christmas market, has been developed at the Hertfordshire Institute of Technology at St. Albans, England. The plants are subjected to short-day treatment for the first three weeks in August and thereafter they are brought back into full-day conditions. This induces the plants to flower two to three months earlier than they otherwise would.

The long days of early August are artificially shortened by placing black polyethylene film (a plastic based on *Bakelite* materials) over the cold frames in which the plants are housed from 5 p.m. to 8 a.m. the following morning. The effect of this is to give the plant a nine-hour day instead of the 15-hour day, which is the normal day length in England at this time of the year. At the end of the month the plants are again back to a long 14-hour day.

Black plastic film has several advantages for this type of work. It is completely opaque, light, easily handled and resistant to the elements. Its initial cost is low and it may be used repeatedly, as it is tough and resistant to the elements.

The flowering of the kalanchoe plants on the left was brought forward two to three months by 'short day' treatment with black polythene film. The plants on the right were untreated

Reader Service

For further information on any item reviewed in this issue please write to:

Reader Service
WORLD CROPS,
Leonard Hill House,
Eden Street, London, N.W.1,
England

'Frio'

This is the name given to a new variety of heavy-yielding winter wheat which has been developed in Germany and is a cross between an English Biffen wheat with the Hungarian Kankut 121. It is a heavy-yielding variety which is resistant to mildew, loose smut and rust.

Its characteristics are: straw—medium long and stands well; ears—white and rather dense; grain—red, uniform and of medium size. In common with other high-yielding varieties, the derived flour has medium baking qualities.

'Frio'—a new winter wheat

The new hybrid, offered by *Hurst & Sons*, has undergone many trials in areas between southern England and central Scotland and the results have shown that it is very winter hardy, moderately resistant to drought and is suitable for either medium or highly fertile soils.

Control of Fungus Infections

The disease botrytis of lettuce is caused by the fungus *Botrytis cinerea*, which gains entry into the plants through tissue already damaged mechanically or by other disease organisms. An important cause of this preliminary damage is rhizoctonia, which builds up in soil under intensive cultivation. This fungus can now be controlled by treating the soil with 'Botrilex', a fungicide produced by *Bayer Agriculture Ltd.*

Control of rhizoctonia infection is not only achieved, but the treatment will also control botrytis itself, should it appear as a result of mechanical damage. The treatment is safe and simple and provides an economical remedy for a disease which can cause considerable loss of lettuce grown in cold frames. The cost of protection throughout the growing season is said to be only a few pence per sq. yd.

World Crop Reports

Groundnut and Jute Production

INTERNATIONAL REPORTS

Groundnuts

World production of groundnuts in 1958 is forecast at 15.5 million short tons (unshelled basis), almost 6% above the previous record of 1957 and one-third larger than the 1950–54 average.

The expected increase of 840,000 tons from 1957 is due principally to expansion indicated in mainland China and India, and larger crops in the U.S.A. and Brazil. Favourable reports indicate that the out-turn in French West Africa may reach the previous year's record and that the harvest in Nigeria may be a near-record.

North American production is up one-quarter from 1957, mainly as a result of the 30% increase in the *U.S.A. Mexico's* crop is up about one-quarter. The rise in U.S. production indicates record yields, as the acreage picked and threshed this year, although up 3% from 1957, is 26% below the 10-year average.

The South American groundnut crop harvested last spring was about 20% greater than in the previous year. *Brazil's* production increased 75% from 1957, mainly because the acreage was increased by almost 60%. In *Argentina* acreage rose 8%, but adverse weather late in the season reduced the out-turn by 9% compared with 1957. Groundnut production in both Brazil and Argentina currently is more than double the 1950–54 average out-turn.

Early forecasts indicate a crop in Africa somewhat less than last year's record. In *French West Africa* the commercial crop is tentatively forecast at 1.2 million tons or about the same as the 1957–58 crop – 1,176,850 tons. There is no indication of any reduction in plantings in Senegal, the major producing territory, and plantings were heavy in Soudan and Niger. Total production is expected to approximate the estimated 1,560,000-ton output of 1957–58.

In *Nigeria* it is doubtful whether the 1958–59 crop will be as large as the 1957–58 record. Acreage increased, but dry weather is expected to reduce yields substantially in some areas. Production is estimated at about 1,150,000 tons, compared with a total of around 1,375,000 last season.

Groundnut crops in most other important producing areas of Africa this year are expected to approximate last year's out-turn.

The 1958 groundnut crop in Asia may be 8 to 10% larger than last year. *India*, the world's largest producer, is expected to harvest an all-time record of around 4.9 million tons, which would exceed the previous record in 1957 (1957–58 crop) by 3%.

Prospects for the new crop are good in nearly all producing areas. Plantings were increased by a million acres in 1957–58 and are expected to expand another million acres in 1958–59. This reflects a 15% acreage expansion in the last two years. Production has not increased in proportion, as yields have fallen sharply since 1956. Growers, particularly in Bombay State, are increasing acreage at the expense of grains and other crops.

Mainland China has reported a substantial increase in groundnut production this year, following improved weather and additional irrigation. The crop is expected unofficially to be around 3.3 million tons, compared with 2.8 million tons last year.

Groundnut crops in *Indonesia*, *Burma*, *Thailand* and *Taiwan* are reported to be up slightly.

Jute

World production of jute in 1958 is estimated at about 4,432 million lb., compared with 4,245 million in 1957. This is 44% more than the 1946–50 average of 3,075 million lb.

Supply of jute fibre is adequate for world needs in 1959. Crop increases are reported in India, Brazil and Taiwan. Early information indicates that the Pakistan crop will about equal the preceding one. The unusually small Taiwan crop in 1957 was the result of unfavourable weather.

Pakistan produced 55% of the world's raw jute in 1958; India 41% and Brazil 1.7%. Pakistan and India together have increased production over the pre-war average by more than 1,000 million lb., or 30%. Brazilian production increased rapidly up to 1956, but there have been small decreases in the last two years.

Pakistan furnishes almost all of the supply of raw jute to non-producing countries and large quantities to Indian mills. Unfavourable weather in Pakistan reduced yields and enforcement of Government acreage controls was discontinued in mid-season. Later reports on the crop are more favourable than the early ones; however, the harvest is delayed by as much as four to six weeks. Acreage is reported at 1,562,619 in 1957, compared with 1,230,264 acres in 1956. The 1958 acreage is larger than last year's.

Raw jute consumption in Pakistan is expected to increase slightly in 1958-59, if difficulties of power supply, factory costs and the labour can be overcome enough to make headway in the programme of improving mill efficiency. It appears likely, however, that supplies again will exceed combined domestic use and exports. Stocks, therefore, will accumulate further.

Exports of fibre from Pakistan decreased in 1957–58 to 1,890 million lb. from 2,224 million in 1956–57. They probably will increase somewhat in 1958–59, although the quantity moving to India is expected to drop as Indian domestic supplies increase. About 315 million lb. went to India last year. In 1957–58 Pakistan exported 263 million lb. of raw jute to the U.K., 921 million lb. to continental Europe, 153 million lb. to the Western Hemisphere and 141 million lb. to Asian countries other than India.

Jute production in *India* this year is expected to be 1,800 million lb., and mesta production 600 million lb. Mesta is used along with jute in the jute mills. Production in 1957 was reported officially at 1,635 and 485 million lb., respectively, from 1,754,000 acres in jute and 726,000 in mesta. As usual, trade estimates for the year were substantially larger than the official figures.

Egypt

Egypt's 1958 *wheat* crop, estimated at 51.9 million bushels, is the smallest harvest since 1952. The reduction is the result of a reduction in acreage, for record yields have been obtained.

Acreage now being seeded for harvest in 1959 is expected to be back to normal, since the Government has announced that growers must comply with the existing law fixing the wheat acreage at not less than one-third of the total area under cultivation.

Philippines

Philippines *copra* production in the first three quarters of 1958 is estimated at 853,527 long tons, a decline of 14% from the corresponding period in 1957.

Coconut oil production in the first nine months of the year was 159,284 long tons, an increase of 7% over the same period in 1957, and copra cake and meal production, at 80,906 tons, was 7% up.

Desiccated coconut production, however, only totalled 38,027 tons – a drop of 6% from the comparable period last year. This is attributed to high production costs, difficulty in obtaining supplies of nuts and a strike at the largest desiccating plant during the first two months of the year.

Jamaica

Jamaica's 1958 *sugar* production is now placed at 391,000 short tons – 41,000 below earlier estimates. This is nearly 6% below 1957 and 10.5% less than the crop forecast for 1959.

Drought during the first four months of 1958, followed by three months of very heavy rains, reduced cane production to only 3,625,000 short tons, compared with 3,795,000 short tons the previous season. This unfavourable weather not only reduced the quantity of cane available, but also its sucrose content.

Brazil

Brazil's 1958 *carnauba wax* crop, now being harvested, is reported by producers to be about as large as the 1957 crop, estimated unofficially at 14,500 short tons. The 1958 crop is also said to be of somewhat better quality than last year's. Exports of carnauba wax in 1958 are expected to be about 12,500 short tons, compared with 13,200 in 1957.

The wax palm is one of the few products of north-east Brazil that has thrived under severe drought conditions. Producers say that the dryness improves the quality of the wax and minimises mould during harvesting and initial processing.

Turkey

The 1958 *pistachio nut* crop in Turkey is unofficially forecast at 9,500 short tons, unshelled. This is a considerable increase over the latest estimate of the 1957 crop, which has been revised sharply downward from earlier estimates. It is now believed that the 1957 crop amounted to only 2,200 tons.

Early estimates place the 1958 *tobacco* crop in Turkey at 242.5 million lb., 8% less than the revised figure of 264.6 million lb. for the 1957 harvest. Most of the decline is in the Aegean, where dry weather affected the crop more than in other tobacco-producing regions. In the Marmora and Black Sea regions weather has generally been favourable; growers expect a good-quality crop in these areas, with more American-grade tobacco this year than last.

West Germany

The latest estimate of West Germany's total 1958 crop of *tobacco* is about 44 million lb. – down about 2.5% from last year.

Flue-cured production in 1958 is placed at about 6 million lb. – up 9% from 1957; Burley and other light air-cured, nearly 15 million lb. – up 4% from last year; and dark air-cured (mainly cigar leaf) at 23 million lb. – down about 8% from 1957.

Spain

Spain's 1958 *wheat* harvest was above average, but not up to the high level of 1957. It is estimated at 162 million bushels, compared with 180 million in 1957. Exports of both grain and flour are planned, as supplies are in excess of domestic requirements.

Wheat yields in 1958 were about 10% below the very good yields of the previous year. This was attributed to spring drought in parts of Aragon and Catalonia, severe outbreaks of rust in some areas, summer storms and a shortage of seasonal farm labour.

Europe

Early indications show a *potato* production in Western Europe of approximately 1,690 million cwt., compared to 1,719 million cwt. last season.

There has been some damage to late crop potatoes in Ireland, England, Northern France and Belgium, largely caused by excessive rain for several weeks, and there is some apprehension of expected losses during storage.

In some of the heavier producing countries of Northern Europe only about one-third of the potato crop is used for food, and the balance for stock feed, seed and industrial purposes, such as the production of starch and alcohol.

England and Wales

Conditions generally were not favourable either for cultivations or field work. Some progress was made early in December on light land, but in most areas work was less forward than usual. Less winter corn than usual had been sown; satisfactory seedbeds were difficult to obtain in many districts.

Early-sown *wheat* crops were generally satisfactory, but later sowings have been slow to germinate. Slug damage was widespread and some waterlogging was reported. *Barley* is generally satisfactory; slug damage appears to be slight. *Oats*, on the whole, were healthy, but were backward in some areas; slug damage was reported from several districts. *Rye* looked well. *Beans* were satisfactory, although germination had been slow in some areas.

Some sprouting of *potatoes* was reported, but, on the whole, potatoes were keeping well in clamps and stores. Most of the *sugar-beet* crop had been lifted, but harvesting conditions had been difficult and dirt tares were high. Some deterioration of roots in clamps was also reported.

Leys continued to make good growth and to provide feed where not too wet, but considerable poaching was reported from most areas. Permanent pastures made some growth and in many districts keep was more plentiful than usual. Poaching was common and grazing was restricted on the heavier soils.

Acknowledgement is made to *For. Crops & Mark.* and to *Spec. Reg. Inform Services* for much of the information contained in the above reports.